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SOME ASPECTS OF GRASS-FARMING ADVANCEMENT IN NEW ZEALAND.

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[Following a conference held in 1930 relative to grassland questions, Mr. W. V. Blewett, of Imperial Chemical Industries, Ltd., personally donated the sum of £20 as a prize for an essay competition on the subject of grass-farming advancement in New Zealand, with special reference to field and research work and possible methods of co-operation among our grassland workers. The essay was limited to 10,000 words in length. Judging of competing essays was delegated to a committee consisting of Dr. H. H. Allan (Plant Research Station), Professor G. S. Peren (Massey Agricultural College), and Mr. L. J Wild (Feilding Agricultural High School). The competitors, twenty-three in number, included many prominent workers from our main organizations engaged in research or instruction in this branch of knowledge The committee unanimously awarded the prize to Mr. Connell's paper here published]

RELATIVE HIGH PRODUCTION OF NEW ZEALAND GRASS-FARMING.

THERE are several outstanding facts that must be considered in any useful study of New Zealand grassland work. One of the foremost of these facts is that while there are many deficiencies in the present average standard of New Zealand grass-farming, yet the better-class New Zealand farmers are in the van, when lined up with the better-class farmers of all countries, as regards their results in the profitable growing of grass and the converting of that grass into cash. This fact has been attested to by overseas visiting authorities competent to express reliable and disinterested opinions. During recent years we have had the published impressions of such visitors as Professor Stapledon, Sir John Russell, the leaders of the party of British farmers, Dr. Wing of Cornell, and Dr. Russell of Wisconsin, all of whom expressed mingled surprise and admiration at the standard of our grass-farming.

But, apart from such authoritative spontaneous testimony, we have the evidence provided by comparison between production from grass in New Zealand and that in other countries. A production of 200 lb. to 300 lb. of butterfat from an acre is not at all rare in New Zealand; in other countries it is phenomenal, if it has been recorded at all. Likewise, the New Zealand sheep-farms which have been made capable

of providing sustenance sufficient to meet well the requirements of six or seven ewes to the acre seem to have few or no counterparts in other countries. The fact that our better-class farmers are not equalled, as a rule, by farmers of other countries, in point of production from grass, drives home the futility of seeking much inspiration or guidance from the grass-farming of other countries.

Considerations regarding Value of Overseas Experience.

On the part of some there has been a tendency to attribute to imported teachings a value which there was no assurance they possessed. Two recent instances rather well illustrate the possibility, unless proper care is taken, of attaching artificial values to overseas happenings.

The first is the Tollesby Farm experience of Mr. Brunton, which has been featured in advice given to farmers. With dairy cows, under his system Mr. Brunton secured annually 317 grazing-days an acre. In comparable New Zealand trials, with much less special effort, in some dozen of instances well over 400 grazing-days an acre have been secured—a fact which assists in viewing Mr. Brunton's performance in its true standing. The second is the Hohenheim experience, which has often been advanced as impressive evidence of the outstanding value of a particular system of grazing management. The fact that under the Hohenheim system the production obtained was equivalent to approximately 160 lb. to 180 lb. of butterfat an acre annually would tend probably to give New Zealand farmers who were not previously aware of it a new perspective relative to the Hohenheim results, particularly if they knew the acre production of good New Zealand farms. From the foregoing facts it does not follow that such experiences as those of Tollesby and Hohenheim are of no value to New Zealand: they are always likely to be instructive and therefore valuable. The danger lies in overvaluing them.

It may be contended that it is to our external circumstances rather than to our personal efficiency that we owe our outstanding position as producers from grass, but even if this is so it does not affect the conclusion to be drawn from the data just considered. The conclusion is that in view of the high production obtained by our leading farmers the most promising source of leadership in grassland practice is within ourselves. The fact that others have poorer production because of external circumstances is away from the point, because circumstances enter into the essence of the matter. The outstanding position of New Zealand grass-farmers should give a sense of pride, but also of responsibility in that it shows we cannot lean on others but must evolve our own means of progress. It would be difficult to overimpress this on some who endeavour to give guidance on grass-farming through the columns of the press. Once the true position is properly grasped there should be less inclination to offer as guidance what often is of less than no value as guidance—real or supposed overseas developments. To avoid any chance of misconception it may be as well to state that while we should be self-reliant we should not be self-centred—we should not neglect to study developments overseas. The recent work of Linehan and Mercer in regard to rye-grass well exemplifies the need of keeping in touch with work of other countries.

Present Knowledge not fully applied.

Another outstanding fact relative to our grassland work is a regrettable failure to apply fully the knowledge that is available. This failure is demonstrated by the fact that we find repeatedly certain farmers whose returns are 40 per cent. or more better than those of many of their neighbours operating under similar conditions of soil and climate. The following instances typical of the position are recent developments :—

In three years Farmer A increased his butterfat-production from 15,000 lb. to 30,000 lb. butterfat annually on a farm typical of an area of 80,000 acres. This was done by the introduction of methods accepted as standard by those acquainted with recent developments. The striking increase in production is only one of the significant aspects of this performance. The other is that the production of much of this 80,000 acres is still at the point where the production of the particular farm was prior to the introduction of approved modern practice.

As if it were to demonstrate that the performance of farmer A was in no way freakish, Farmer B, operating in similar country, has raised his production in six years from 7,900 lb. to 21,000 lb. of butterfat. Again this was done simply by the introduction of approved modern practice.

On totally different country Farmer C in five years raised the carrying-capacity of a farm of 1,000 acres from 1,400 ewes to 3,000 ewes. This was done by the adoption of ordinary up-to-date practice. Again, generally, the neighbouring farmers are in a similar position to that of C four or five years ago.

That instances similar to the specific cases cited could be multiplied, and that such cases are indicative of the position generally, is rather strikingly confirmed by official data recently made available as a result of studying 1,600 dairy farms extending over 200,000 acres. It was found that while the returns of 10 per cent. of these farms were good, the results of 67 per cent. were of an intermediate or indifferent type, and the returns of 23 per cent. were poor or disappointing. The superiority of the 10 per cent. of farms obtaining good results must be due essentially to the application of knowledge now available. If the position were remedied so that farms obtaining the intermediate and poor types of returns obtained good returns, then our dairy production would approximately double. At first sight this may seem an over-optimistic estimate, until it is considered in the light of the fact that during a recent decade our dairy production was doubled and that this was obviously done without minimizing our sheep industry, since the sheep population increased by several millions during the same decade.

As those obtaining the highest results were most likely not fully exploiting our present knowledge, it is indeed difficult to gauge accurately the full potentiality for increased production in complete exploitation of our present knowledge. The potential improvement from thorough application of our present knowledge appears to require some emphasizing, for the impression seems now to be in the minds of some that the only avenue to any substantial improvement in production is research.

There will be later reference to the need for research, but in the present connection it seems worth stressing that while, on the one hand, the results from efficient work concentrated on research are to some extent of problematical value as means to increased production, in that research may tell us simply that many of the practices approved of to-day are really the best, on the other hand, the results from fully efficient and general application of our present knowledge mean a very substantial advancement of our grass-farming.

Facts underlying Poor Application of Knowledge.

It may well be asked, Why do many farmers fail so lamentably in making use of our available knowledge? Contact with farmers has shown that the main causes of this are as follows, no attempt being made to name them in the order of their influence: (1) Financial considerations—farmers know what to do to achieve better results, but are deterred from doing it by financial considerations; (2) indifference, mainly operative when a comfortable living follows present inefficient methods; (3) lack of knowledge of the information available; (4) knowledge that information is available coupled with hesitation to accept such information as reliable guidance to better farming.

Nature of Sources of Knowledge regarding Pastures.

The fourth of these causes is worthy of consideration in an examination of our grassland work. Why is there hesitation to accept some of the information offered, it may well be asked. Instructional work is at times linked with field experimentation involving the use of plots. There seems to be a widespread feeling among farmers that at times they cannot place a great deal of reliance on the evidence provided by such plots. Farmers who readily admit the need for investigation and who allow that the specialist worker may find plots of value in his work yet act on the belief that such plots by themselves do not provide reliable guidance to better farming. In this connection the farmer may not be illustrating his unreasoning conservatism, as some would hold, but his good judgment, which possibly has enabled him to recognize, more readily than those who would teach him, the shortcomings of the plot system. Of prime importance among these shortcomings is the questionable validity of the means of measuring plot results—a matter which will be discussed later.

The tendency to question the reliability of recommendations based on field plot work applies, but more intensely, to recommendations based on laboratory determinations.

Such considerations bring up the question of basing advice on evidence other than that derived from field plot or laboratory investigation, and make it opportune to recall that there is a wealth of practical knowledge to be gained from a thorough study of general farm experience and that such knowledge would as a rule readily gain the confidence of the farmer. Two instances, both of which have been obtained from official sources, may be cited.

In the first instance, examination of the farms of a district showed that they could be divided into two groups which were similar in respect to soil, size, top-dressing, and average yield of herds, but that in one group the pastures were not allowed to become long and mature in the

summer, while in the other group the pastures became long. In the former group the average butterfat-production an acre was 30 per cent. higher than in the latter. One can imagine farmers readily accepting the conclusion to be drawn. In the second instance a study of 210 herds showed that, with those that averaged from 300 lb. to 350 lb. butterfat a cow, over 7 cwt. of phosphatic top-dressing per cow was used, whereas with those herds averaging under 220 lb. per cow the amount of phosphate used was less than 4 cwt. a cow. From such facts we have a finding that the farmer would not be inclined to question.

The matters just considered lead naturally to another fact of considerable importance. This is that the bulk of the knowledge on which our present relatively efficient practice is based has come not from the laboratory or from trial plots, but from the field work of the practical farmer. To exemplify this we need only recall the origin of our knowledge of such matters as top-dressing, ensilage, and the high nutritive value of leafy grass. At times the field plot and the laboratory have facilitated progress in a valuable way, but at times, again, if the practical farmer had followed the field plot or the laboratory findings, he would have gone astray. There is, for instance, a district in which in field plot trials no evidence of benefit from the application of phosphatic top-dressing can be found, even when plots which have received 9 cwt. an acre of phosphate in three years are compared with adjacent control plots. Yet when the cash returns of farms of the district which have been top-dressed are compared with the returns of similar ones which have not been top-dressed, there is indisputable evidence of profitable responses to the top-dressing. In such a case trial-plot evidence was obviously misleading.

Enough information has been given to make it clear that we should not neglect the opportunity of learning from farmers themselves by suitably collating the experiences of many farmers. We should remember that farmers as a class are extremely practical research workers, and that the value of knowledge obtained from them has been demonstrated.

THE NEED FOR RESEARCH.

A further important fact of the grassland position is that there is great need for extensive research. Despite any view or fact in the foregoing statement that may seem to imply a contrary conclusion, research is essential to the fullest measure of success. To indicate the important bearing of research one need only describe briefly some of the problems that are calling for solution.

The subject of top-dressing alone provides many problems of economic importance. There is, for instance, little or no definite knowledge regarding the returns from much of the lime, potash, and nitrogen applied to New Zealand grassland. Possibly the amount of money spent on these fertilizers should be greatly increased: possibly it is being largely wasted. There is likewise much indefiniteness about the best use of phosphatic fertilizers. In brief, there are dozens of important points regarding top-dressing about which we can express only opinion, whereas knowledge is most desirable.

Those who to-day are best informed in regard to pasture establishment also most completely realize how imperfect our knowledge about

it is and what promising fields it offers for successful research. The relatively recent developments in regard to strains of rye-grass are but a foretaste of what might follow from thorough exploitation of differences between strains of other pasture species, while the most advantageous use of the different pasture species is a matter about which our knowledge is still decidedly vague.

In the vital matter of pasture utilization there is yet much unexplored ground. The practice of rotational grazing, about which some are prepared to proffer such specific instruction, rather well illustrates the position. If a request were made for the evidence on which such specific instruction is grounded, then generally those responsible would have some vain searching.

While some are prepared to be dogmatic in regard to the details of pasture cultivation by harrowing, &c., many of those who have given the matter close and extended study would welcome considerable further research. This brief outline must suffice to illustrate the scope for research into methods of grass-production.

Importance of Management Problems.

In drafting any programme of grassland research it is of extreme importance to remember that the grass-farmer is faced not only with problems relative to the technique of grass-production, but also with problems relative to the management of grass-farms. In the former problems the pastures are the units of study; in the latter the farms as a whole are the units. In the former problems the essence of the matter is the efficient growing of grass; in the latter it is the making of profit. From this it would seem to follow that the efficient growing of grass is not necessarily sufficient by itself; and this is actually so, for the benefits that might be expected from efficient growing of grass are nullified if the resultant feed is not used advantageously. In short, farm-management as distinct from grassland-management governs success. It is of particular moment that attention be given to problems of grass-farm management, for in the past, rightly or wrongly, these problems have not received much systematic study. Possibly in the past the technique of good grass-production was so poorly understood that it warranted the greater share of attention, but now, seeing that our knowledge of technique has been so improved, the need for attention to problems of farm-management has become much more acute.

As a rule, unfortunately, farm-management problems are of greater complexity and of greater ramification than farm-technique problems, and possibly this explains why we have been somewhat slow in attacking them. Probably the nature of these grass-farm-management problems will be indicated most readily by citing the following specific ones which have recently presented themselves :—

(1) When increased grass-production on a one-man dairy farm wholly in grass may make it necessary to employ another man for milking, although there is not enough work for two full-time workers, what should be done?

(2) When the whole of the pastures of a farm are in good order, what circumstances determine the advisability of breaking up some of the good pastures in order to grow supplementary crops?

(3) What classes of farms are exceptions to the rule that every grazing farm should practise ensilage annually ?

(4) Under what circumstances is it profitable to introduce sheep to dairy farms ?

(5) In North Island farming, what circumstances justify a change-over to the use of Southdown rams ?

These few instances of farm-management problems will suffice to show, firstly, that they have originated in modern grass-farming developments, and, secondly, that it is impossible to solve them by means of any formal field experimental work.

Basic Problem lies in Technique of Investigation.

This brings us face to face with a fact that applies not only to this class of problem, but to many of the other problems already mentioned. This fact may be stated by saying that the biggest problem of grass-land research to-day is the discovery of efficient methods of investigation. At first sight, to the layman at least, the greatest difficulty in the sphere of research is the securing of funds, equipment, and staff for the carrying-out of the work. It is assumed that, given the men and the money, it would be an easy and simple matter to find out the answers to the problems which confront us. Actually, if there were an ample supply of men and money, there would be no assurance of immediate sound progress towards a solution of many of our problems that seem so straightforward.

The difficulty wholly arises from the extremely doubtful validity of commonly utilized means of measuring differences in field experimental results. Let us consider this matter more particularly, for it is one of prime importance. Assessing of differences among trial plots by mere observation is generally recognized as a crude method at best—which may be of some service, but only until one wishes to express differences in terms of financial returns. The adoption of a system of mowing and weighing of herbage from plots might seem to eliminate to a large extent the weakness of observational means of ascertaining differences in results, and this is particularly so when we find this method linked up with an authoritatively designed and elaborate system of eliminating the disturbing influence of soil and other variations likely to occur in a series of plots. But the value of the whole system of mowing, weighing, and calculating is immensely discounted in practice by the fact that the system ignores the factor of quality in herbage, which is already known to be of basic importance ; and, as if this were not enough, it has been found that mowing, if continuously persisted in, speedily gives a sward substantially different from what would have resulted from a similar period of grazing. Hence an investigator utilizing the mowing method for the determining of differences in trials regarding grazing problems would soon find himself determining differences of no particular value, because they would have no counterpart in practice. A system of alternate grazing and mowing would minimize this weakness, but it would not surmount the difficulty of assessing herbage quality. It has been thought that to supplement the results obtained from this latter method by data obtained through chemical analysis of the herbage would enable grass-land experimental results to be measured efficiently. But it has been

found that available methods of chemical examination do not satisfactorily indicate such matters as palatability and digestibility of the herbage; and these factors would seem to be far too important to be overlooked in any investigational work which aims to supply reasonably accurate guidance.

From this brief account it becomes clear that there is doubt whether, in respect to experimental methods, research workers to-day are very far in advance of research workers of thirty to sixty years ago when the animal was used for measuring the results of trials designed to indicate the comparative nutritive value or quality of feeding material. There is some encouragement in the fact that the investigations of that period yielded some most valuable information. During that period, for instance, took place the epoch-making work of Fjord which gave us the Scandinavian feed-unit system that incidentally played no small part in enabling Denmark to take the place she occupies to-day as a producer of butter and bacon. "I am doing no more than making systematic records of the experience of practical farmers" was a frequent expression of Fjord's when speaking of this important work, and that expression surely is of significance to-day. During the same period also was commenced Somerville's classical work at Cockle Park, and allied trials which had such a pioneering influence in fostering phosphatic top-dressing. Somerville, it is interesting to find, insisted in his report that the animal is the only effective measure of the results from top-dressing and other grassland practices.

It is well to examine carefully whether we have made any progress in the technique of pasture trials since Somerville's pronouncement.

Problems illustrating Difficulties relative to Technique.

Apart from any question of its accuracy, the method of employing stock to measure results in grassland investigations is costly and cumbersome, and it is on this account principally that alternative methods of measuring experimental results are sought. The question may fittingly be raised whether we do not tend to go too far at times in our search for simple experimental methods—whether we do not attempt the impossible task of making simple that which is inherently complicated. Two current problems seem to illustrate this rather well. In the first place, we have the matter of North Island hill-country top-dressing. Is it reasonable to expect ever to be able to obtain worth-while information on this matter by any investigations except those in which farms, not plots or fields, form the unit of comparison? The futility of comparisons between plots or fields is suggested by the fact that top-dressing may influence not only stock-carrying capacity, but also stock mortality, quality of stock, date of buying and of selling of stock, which in turn might affect prices, quantity of wool, quality of wool, and possibly other matters besides—a potential complexity of influences that baffles simplification.

In the second place, we have the matter of nitrogenous top-dressing of dairy farms. Such top-dressing, through providing extra growth at critical times, may lead to an all-the-year increase in the number of cows milked. Indirectly this may lead to the more economical utilization of feed which, failing the use of nitrogen, would be poorly utilized or wasted. Further, it may lead to the elimination of the necessity

for costly special crops. From all this it seems clear that the returns from nitrogen top-dressing are not to be measured by finding out the number of extra pounds of butterfat produced on the fields to which the nitrogen was applied, or by merely finding out the increase in the amount of grazing on those fields and calculating this extra grazing in terms of butterfat or its cash equivalent. The crux of the position lies in the fact that the nitrogen top-dressing may influence the returns from fields to which it was not applied, because the use of nitrogen on certain fields may enable the grass growth on other fields to be more effectively utilized.

The problems of North Island hill-country top-dressing and of nitrogenous top-dressing of dairy farms are typical of a class which will probably grow in number as our grass-farming becomes still more improved, and which does not seem to give promise of solution by any simple measures. That improved grass-farming would beget such problems is confirmed to some extent by certain problems which already seem to be looming. One of these is the possibility of winter butterfat-production as a fairly general thing. Men who hold responsible and authoritative positions in the marketing world have pointedly advocated all-the-year-round dairy production as a dependable means to better returns from our dairy-produce.

There are two recent developments which bear on the position:—

(1) Data submitted by the Farm Economist, Department of Agriculture, support the view that all-the-year-round production may be expected to be favourably reflected in our marketing. The data show that (*a*) New Zealand butter approaches Danish in price not when there is a scarcity of total butter or of Danish butter on the British market, but when there is a scarcity of New Zealand butter; (*b*) that the New Zealand price slumps below Danish not when there is a glut of total or of Danish butter, but when there are abnormally heavy deliveries of New Zealand butter. In fact, the official figures suggest that, to an appreciable extent, the biggest competitor of New Zealand butter is other New Zealand butter, and that the competition between New Zealand lines of butter is the main cause of big differences between prices of New Zealand and Danish butter. This is what even a slight knowledge of marketing would lead one to expect, seeing that New Zealand, according to official figures, has been delivering over 53 per cent. of her total output on to the British market within four consecutive months.

(2) Recent modifications in our grassland practice relative to top-dressing, ensilage, &c., seem to have made winter butterfat-production not such a remote possibility as it was held to be prior to the introduction of these modifications. Further, prospective increases in our output of dairy-produce promise to increase the urgency of spreading our output more evenly on the market. The problem is whether it will be an economic proposition to spread dairy-produce deliveries by means of winter production. It is a particularly instructive problem in its bearing on the main subject herein considered. It is just as much a grass-farming problem as it is a marketing problem. It illustrates very well that any programme of grassland work should embrace not merely the technique of production, but also the management or business side of grass-farming. It illustrates also the class of problem calling

for investigation by methods other than those which employ the field plot or the laboratory, and finally it introduces the difficulties attaching to the technique of investigation.

In relation to the space available the problem of experimental technique has herein been given considerable attention because it is one of the greatest affecting the advancement of grass-farming. It certainly is of basic importance, since, until sound methods of carrying out investigation have been evolved, the value of any investigational work may eventually be greatly discounted because of the discovery that the methods used in seeking the solutions were not fitted to supply the information sought. Indeed, the adoption of unsound experimental technique may be productive not merely of results of little value, but of results which are actually harmful, in that they may misinform and thereby lead to the adoption of uneconomic practices.

Major Matters regarding Research summarized.

To sum up on the matter of grassland research, while there is much scope for valuable work in the main aspects of grass-farming, there are two matters to which attention specially requires to be directed, because, firstly, of their intrinsic importance, and because, secondly, of the fact that there is a tendency to unduly ignore them. One of these matters is research into the business of grass-farming as distinct from research into the technique of grass-production. The other is research into the technique of research. In other words, let us ask ourselves how we may efficiently ask the questions to which we desire answers; what tools and what materials we may use in efficiently solving our problems. It is somewhat regrettable that to the average layman this great fundamental problem of experimental technique scarcely exists, and so any suggestion of expenditure on the problem will be apt to be viewed with a mixture of disfavour and curiosity by the general public. Actually, to proceed with certain types of important research until this problem is solved is to take the risk of building on very unsound foundations.

Fundamental Facts relative to Organization of Grassland Work.

A most important further fact is that grassland advancement constitutes a unit task which can for convenience of examination be divided into the following activities: (1) Determination of the real problems of grass-farming and of the relative urgency and importance of these problems; (2) discovery of truths which solve the problems; (3) dissemination of these truths so that our knowledge may be applied.

That these three activities are but parts of a single task is readily discovered by considering either the probable effect of eliminating any one of the three from a scheme of grassland advancement, or the probable effect of isolating one and concentrating attention on it to the neglect of the others. In either case inefficiency would soon become apparent. What is required is a well-balanced combination of the three activities. To obtain this, team work is essential, as it is for any other similar human enterprise.

Further, it has become practically axiomatic that there can be no surety of efficient team work except on the basis of unity in planning and direction. The fundamental weakness of New Zealand's grass-farming

work is lack of unity in planning and in direction. What body, it may well be asked, has the authority, combined with the knowledge, to preserve a proper balance between research and advisory work ? What body has the power to prevent one branch of research being fostered unduly at the expense of other equally worthy branches ? What body has the power to ensure that money is not spent on matters which are of relatively little consequence while may be other matters of prime importance are being neglected ? What body has the power to prevent unnecessary and therefore wasteful duplication of effort and equipment ? No body has such power, and therein is the weakness.

Were all the work of grassland advancement placed in the hands of one body the weakness would disappear. In considering practicable ways of eliminating or minimizing the weakness we may begin with the fact that the work of enunciating our grassland problems and of fostering the application of our grassland knowledge has been, and is, almost wholly in the hands of the Department of Agriculture, which is the only organization that has the widespread direct contact with the farmer that is so essential in the successful carrying-out of such work. Further, a substantial amount of grassland research work is conducted by the Department of Agriculture, which, however, shares this research work with several other institutions. Linked with this sharing of research work among several institutions is fragmentation of effort.

Evidence of this fragmentation of effort is by no means scarce. We have, for example, at least four chemical research units working on lime questions ; at least three organizations dealing with strains of pasture species, and similarly in regard to top-dressing, utilization, and other grass-farming matters. Mere fragmentation is not a weakness, but it frequently means that some matters are wastefully duplicated or that some are neglected. Hence its presence makes one suspicious of some loss of efficiency and of economy. Fragmentation of effort is particularly likely to be disadvantageous when there is multiplicity of control as there is now in New Zealand grassland research. With multiplicity of control there is likely to be absence of any binding authoritative influence to ensure that eventually the fragments may be cemented into a useful whole.

Possible Means to Control examined.

It is in the interest of New Zealand that the binding influence should be supplied. In view of the fact that the Department of Agriculture is already responsible for the major share of the work of grassland advancement it would seem logical and businesslike to make the Department responsible for the remaining share, and all evidence suggests that this would be the ideal remedy for our present weakness in the organization of grassland work. Such a course would enable the advancement of grass-farming to be fostered not piecemeal, but as a commercial and biological unit or whole. Such a course, though the ideal one, may however be ruled out as impossible in view of financial and staffing arrangements already made in respect to other organizations. The position is a repetition of the old saying that it is not easy to replace an established arrangement even by one which promises to give better service. Assuming that the placing of all grassland work

under the Department of Agriculture must be ruled out, it becomes necessary to ask what alternative type of organization would be an improvement on the present state of affairs.

The vital point in an organization is its control; unless the control or direction is suitable the whole structure is likely to crash. Two main types of control of grassland work suggest themselves as alternatives to control by the Department of Agriculture. The first is control by a new grassland institute. The second is control by the present directing bodies supplemented by an agency fitted to foster exchange of views and experiences, and to stimulate general co-operation and co-ordination in the activities of these bodies.

The grassland institute as usually proposed would be representative of farming, commercial, and scientific interests. It would become responsible for the drafting of the programme of grassland work. It would, as a rule, merely supervise the carrying-out of the work which would be delegated to the various organizations already doing such work. The creation of such an institute would have the following decidedly advantageous results :—

(1) It would give the unity of direction which eliminates loss of economy and efficiency, and which tends to proper balancing of the various aspects.

(2) It would assist in ensuring that grassland work received the attention its national importance warrants, in that the institute would naturally try to recruit all possible interest and assistance.

(3) It would, to some extent, remove the work from the influence of politics, particularly if, as the advocates of the institute contend, funds would be forthcoming by levy or contribution from the interests most directly served.

The weakness of such a grassland institute, as has been outlined, is that if it contented itself with delegating to other bodies the carrying-out of grassland work it would have no power to enforce its findings relative to such work. When it suited them these other bodies would obey the wishes of the institute, but not otherwise. This weakness is so serious and fundamental that the mere statement of it would probably be sufficient to damn such an institute in the mind of the public. It reduces the institute to an advisory status. It may be contended that a grassland institute is so inherently sound that it would operate smoothly, so that the development of such a weakness in practice would be a remote possibility, and that in case of such a development it would be open for the institute to remedy the position by carrying on its programme of work instead of delegating it. Thinking along these lines combines specious optimism with a replacement of the original proposal by another one possessing its own weakness. Once a grassland institute embarked on the executing, as distinct from the planning and supervision, of work it would open itself to the charge of being simply an addition to the organizations it set out to unify, and thereby it would provide an admission of having failed dismally in its essential purpose.

To all the points already raised it may be objected that nothing has as yet been advanced to contradict the view that the separate grassland institute in complete charge of all grassland work is the

ideal organization to meet the requirements of the present position. This really is rather easily dealt with, for consideration will soon show that the operations of such an institute would be merely a duplication of the major portion of the extensive duties now being carried out by the research and instructional services of the Department of Agriculture. Why tolerate such a duplication is the first question that the public, with considerable justification, would ask.

Liaison Agency recommended.

There remains one type of control to be considered. It consists of control by bodies at present directing, supplemented by a liaison agency fitted to foster exchange of views and experiences between interests directly concerned and to stimulate co-operation and co-ordination in effort. Such a liaison agency could probably be initiated successfully by the appointment of a special officer whose duties, in a general way, would be to keep both research and advisory officers in touch with the grassland work being done throughout New Zealand. Such contact could be most valuable, for it would tend to remove the danger, always present, of isolated workers getting into grooves. It would probably be advisable to attach the liaison officer to the Department of Agriculture, as this body has already in its hands much the greater part of the work of grass-farming advancement.

The work of such a liaison officer could profitably include the following activities :—

(1) Keeping all those engaged in advisory work provided with ready means of becoming informed about all recent developments in the research sphere.

(2) Conversely, keeping all those engaged in research work in the different institutions fully acquainted with the most recent developments not only in the sphere of research, but also in the sphere of farm practice. A valuable influence of the double exchange of information which this and the previously mentioned activity involves would be the elimination of isolated individual effort which gives evidence of developing. Another influence would be the minimizing of the danger of wasteful duplication of effort. At present, since officers of one organization are not always acquainted with what is being done or has been done in another organization, this danger is considerable. Another valuable influence would arise from the fact that better knowledge between the officers in respect to their work would almost certainly beget co-operation. For instance, it is conceivable that, as a result of better all-round knowledge of what is being done in the grassland world, the chemist of one organization would see how to fit in his work more efficiently with a botanist of another organization and a field officer of a third institution. In this way would arise between the institutions a valuable system of team work that would be a considerable step towards unity of action, which would be welcome and incidentally somewhat unusual in a movement which works without any formal unity in direction.

(3) Bringing about more complete contact between those responsible for advisory and research work, on the one hand, and those

directly interested in the results of that work, on the other hand—for example, farming, fertilizer, seed, and implement interests. From regular meetings of representatives of these interests could be organized a united movement to press the just claims of grassland work to a much greater attention than it is now receiving. To-day the interests mentioned have had no opportunity of framing a national grassland programme. A liaison agency could arrange for such an opportunity, probably by utilizing an association of workers. Further, possibly from such an association would come not only a policy, but funds to supplement those provided by the State.

In brief, the aim of a liaison agency should be to effect gradually the changes which some to-day would attempt to effect in a revolutionary way. It may be taken as a basis of practical planning that unless the state of affairs in the grassland world were very much worse than it is to-day the public that controls the purse would not support any radical changes. This may be partly illustrated by saying that no scheme involving the formation of a new comprehensive grassland organization would find favour. Likewise any scheme involving any other violent changes in our present activities, such as the concentrating of grassland work in the hands of some institutions and the dropping of other institutions from the work, would be resisted, and this probably with such success that the scheme would not be realized. It would seem that to be practical we must be content to proceed to a better organization of grassland work by evolution rather than by revolution. We must seek neither to create any new organization nor to eliminate from the work any organizations now participating in it. Rather the objective should be to work with all these organizations, extend their activities, and weld them into a well-balanced whole by authority arising spontaneously from within rather than by authority forcibly impressed from without. This course may by some be viewed disparagingly as a compromise. It is a compromise. But it is well to remember that it is practicable to deal with certain situations only by a compromise. In grassland work, if we ask for the ideal organization or nothing at all, we are very likely not to get the ideal organization. Why not accept a compromise, particularly if the compromise leaves open a way to improvement of the position later? The liaison agency is the compromise that seems to meet the present position. A weakness of the liaison-agency proposal is that a great deal depends on the person allotted the liaison work. However, this weakness is probably not as serious as some would make it seem, for is not the same weakness associated with all human endeavour?

The magnitude of the benefits that may reasonably be expected from full exploitation of our grass-farming, and the magnitude of the weaknesses and deficiencies both present and prospective which attach to our efforts and organization, justify the initiation of a movement which centres round a liaison agency, and which assumes the goodwill and hearty active co-operation of all institutions and persons interested in grassland advancement. If the liaison agency receives this goodwill and co-operation its success is assured. If it does not, there is something radically wrong, and the sooner this is exposed the better. A new structure could then be erected on a different foundation.

SUMMARY.

The current grassland position in New Zealand is summed up in the following facts :—

(1) The standard of our grass-farming is relatively high, and for guidance to improved farming we must depend mainly upon ourselves.

(2) Full application of our present knowledge would most markedly increase our national production from grassland.

(3) The comparatively poor application of our present knowledge is due to several causes, including ignorance that information is available and hesitation to accept as reliable guidance the advice which is known to be available.

(4) In the framing of future work the practical farmer as a source of sound guidance should not be overlooked, for he has already proved his worth in this connection. Advice based on practical experience specially appeals to those seeking guidance.

(5) There is much scope for valuable research, problems of special importance being (*a*) grass-farm management as distinct from grass-production technique, and (*b*) technique of experimental method.

(6) The advancement of grass-farming is a unit task which calls for unity of control as the foundation of team work.

(7) Under present circumstances the ideal means to unity of control is the placing of all organized grassland work under the direction of the Department of Agriculture, but this course may be ruled out as impracticable.

(8) Other attractive methods of control suggest themselves, but prove open to serious objections.

(9) Probably the only practicable means of effecting greater co-operation in grassland work is a liaison agency.

The sources of all facts and opinions quoted are available. Much of the information quoted is from official sources, and when this is not so it is from authoritative overseas sources.

Dairies supplying Milk for Town Consumption.—There are now close on 5,000 dairies registered for the supply of milk to towns throughout the Dominion, of which 2,193 serve the four larger centres. Referring to the subject, the annual report of the Live-stock Division for 1930–31 states that during the last few years a considerable advance has been made with regard to the type of dairy-shed being erected. The old type of shed, which on account of its construction was difficult to keep in a sanitary condition, is fast disappearing, and new structures built on sanitary principles are being erected, with the result that the farmer is supplying a better commodity than he was able to previously and with less trouble to himself. With regard to the health of cows in registered dairies, that has been well maintained. All animals are regularly inspected, and any suffering from disease are condemned or isolated. In addition to this the tuberculin test has been freely applied and all animals reacting thereto are forthwith destroyed. Further, composite samples of the milk are taken from a number of herds and subjected to a biological test, and should there be positive results the various members of the herd are tested individually. The health of the herds and the standard of cleanliness of the sheds and surroundings are being well maintained.

PRESENT-DAY KNOWLEDGE OF YOLK IN WOOL.

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THE following article is an attempt to bring before sheep-breeders in a readily available form the present-day knowledge of wool yolk—its production, function, and importance in the fleece. In the past a great deal of circumstantial evidence on this subject has been collected, mainly as a result of observation in the field. The ideas of different breeders do not always agree either in principle or detail, but the wide-spread interest in the subject indicates its importance to the wool-growing industry. Within the last few years a considerable amount of research work has been carried out with the object of discovering the precise nature and effect of yolk. The results of this and similar work will in time provide a basis of exact information to which the ideas of practical men can be related, and from which suggestions can be made towards the most effective management of yolk for the production of better wool.

The fleece of the sheep may be considered as consisting of two components—wool and yolk. In the past the manufacturers have regarded yolk as a necessary evil. Yet it is significant that the breeder, who has to consider the wool fibre not as a finished article but as the result of many interacting influences, has not attempted to reduce the amount of yolk in the fleece by selection or breeding. In his mind yolk is given a very important place among the agents affecting the wool fibre, and in general he aims at a plentiful supply of medium-coloured and easy-flowing yolk. Indeed, we have to-day Merino sheep which produce a fleece containing more yolk than wool. This article will endeavour to state what has been learned of the foundation on which the practices of breeders rest.

The abundant occurrence of yolk in the fleece has led to some utilization of the substances occurring in it, in an effort to make yolk an asset rather than a liability. The manufacture of lanoline ointment by purification of the waxy portion of the yolk, which floats on the surface of the scouring-liquors, is an important industry, since lanoline forms the base of many cosmetics and ointments. In some countries potash for use as a fertilizer is recovered from scouring-liquors. Owing to the vast bulk of liquor which has to be handled, this can only be done economically where the wool industry is concentrated within a small district. In England at present efforts are being made to find new uses for yolk and the substances derived from it. One of the most important developments is the use of yolk in place of soap as a scouring-agent. Yolk contains large quantities of natural soaps, and it has long been known that when a certain amount of wool has been put through a scouring-bath the scour becomes more effective, due to the accumulation of yolk in the bath. By the use of settling-tanks to remove dirt and centrifugal separators to remove wax a process has now been devised by means of which it is possible to scour wool by the use of yolk alone. However, such attempts to utilize yolk appear to be merely making the best of a bad job, and by themselves could never be sufficient excuse for the continued production of large quantities of yolk in the fleece.

Further developments cannot originate from the manufacturer, who takes wool as he finds it—that is, laden with yolk—and must utilize it in the most profitable manner.

The wool-grower, on the other hand, has at his command the opportunity to change or improve the fleece in almost any required direction, so that he views the fleece from an entirely different angle. The intimate association of yolk and wool in the fleece immediately suggests the possibility of some essential connection between these two materials. This is a point of considerable importance to both manufacturer and producer—firstly, because the yolk has to be removed by an expensive process before the wool can be utilized; secondly, because the yolk has to be transported with the wool for long distances at considerable cost; and, thirdly, because the production of large quantities of yolk by the sheep must involve the use of energy which might otherwise be devoted to the production of wool. Wool-scouring, like many other trade processes, is an art rather than a science. Its expert performance is based on long practical experience rather than on exact knowledge, and its manipulation to produce any desired results is so closely connected with the use to which the wool is to be put that many manufacturers maintain that it can be carried out satisfactorily only by the subsequent user of the wool or by some one in close contact with him. On these grounds any scheme for carrying out wool-scouring in the producing countries is unpopular with the manufacturers. The value of the by-products recoverable from yolk is not sufficient to meet more than a fraction of the charges for transport and removal. Has the yolk, then, any value in its effect on the fibre sufficient to make its continued production in large quantities in the fleece an economically justifiable procedure?

Since the manufacturer determines the price of wool paid to the producer according to its suitability or otherwise for his requirements, it is well to consider yolk content from the manufacturer's point of view. It has long been realized that a certain small amount of yolk is necessary for the satisfactory processing of the fibre, for the complete removal of the yolk leads to grave difficulties in some of the mechanical processes. This necessary amount is, however, very small—approximately ½ to 1 per cent.—so that it would appear from this point of view that fleeces might very well be grown with much less yolk than is the common practice. Further, we find that it has come to be recognized that a wool with a sufficiency of yolk evenly distributed along the length of the staple tends to be a more even and better spinning wool. Also a good distribution of yolk is a sign of a sound wool. In a somewhat similar manner wools with a good yolk-supply tend to have a better handle, since handle appears to be associated to some extent with evenness.

These views have received interesting confirmation from some work published by Winson(1) in 1929. Working with Australian wools from the same source and ranging from 56's to 64's quality, and two samples of a 50's New Zealand crossbred wool, he compared samples heavy in condition with those containing only a small amount of yolk. The samples had been sorted by Bradford sorters, so that a high degree of correspondence could be expected. He found that the greasy samples differed from the samples of the same quality, but with a

lower yolk content, in that (1) the fibres were definitely finer; (2) in most cases the samples were more uniform in their diameter—that is, there was less variation in the area of cross-section of the fibres; (3) in every case the fibres of the heavy-conditioned wools were more nearly circular in cross-section; and (4) in all cases the variation in shape of cross-section in the fibres of the heavy-conditioned wools was less.

The first two facts make for higher spinning-capacity, while experiments have shown that a high degree of circularity in fibres is also desirable. Obviously, therefore, the wools containing plenty of yolk were more desirable from the manufacturing point of view than those with less yolk. Whether the good wool and the plentiful supply of yolk both resulted from the same underlying cause, or whether the yolk was a contributory factor to the excellence of the wool, remains to be shown. In either case the yolk was at least an indication of the character of the wool, a conclusion at which breeders had arrived independently by practical observation.

In spite of the recognized value of yolk as an indication of the characteristics of the wool with which it is associated, buyers have had a tendency to penalize wool very heavy with yolk, and especially so if that yolk were deep in colour. This attitude has probably arisen from the difficulties encountered in dealing with "canary stained" wool and wools with other abnormal yolks, such as "cakey" yolk, "dead" yolk, &c. In an investigation into the causes of some of these abnormal yolks, a preliminary account of which has recently been published, Rimington and Stewart(2) have made an attempt to determine whether this attitude was justified. It should first be mentioned that an expert can distinguish between these abnormal conditions, such as "canary yellow," and the more normal highly coloured yolks, so that any tendency to penalize coloured yolks because of their superficial resemblance to such abnormal yolks is difficult to justify. Rimington and Stewart found that the condition known as "dead yolk" is completely removed by ordinary scouring methods. In addition they collected samples of wool with yolk varying in colour from bright white to a deep yellow-brown. These samples were scoured normally and then rearranged in order of brightness by various independent experts. It was found that the wools which before scouring showed a deep-coloured yolk were placed first, while the sample showing the greatest brightness before scouring now came fifth. Obviously, then, highly coloured yolk is at least no disadvantage. "Cakey" yolk, on the other hand, though it scours out quite readily, yet because it has not been able to flow evenly along the wool fibre, is not generally associated with the most desirable type of wool.

Furthermore, Hirst(3) has shown that the colouring-matter of the yolk acts as a protective agent against the harmful effects of exposure to ultra-violet rays, some of which occur in sunlight. The effect of such light, working in conjunction with the atmosphere and moisture, is to change the chemical nature of the wool-fibre, as can be seen in the brittle tips of wool inclined to be "tippy" and lacking in yolk in the outer part of the staple. From work done at this College and elsewhere it has been shown that such dry and "tippy" wool dyes

unevenly, the weathered portion of the fibre taking the dye more readily. The development of an adequate supply of yolk will do much to overcome this deterioration.

WORK AT MASSEY AGRICULTURAL COLLEGE.

Considering the evidence quoted above, it can be seen that the amount and nature of yolk produced in the fleece is a question of considerable importance and one to which wool-growers might well pay more attention in the future than they have in the past. The growing realization of this fact led to the undertaking of some work in this connection at the Massey Agricultural College, with some assistance from the Department of Scientific and Industrial Research. The paucity of information available on the subject may be gauged from the vague nature of the original plans, which stated that the

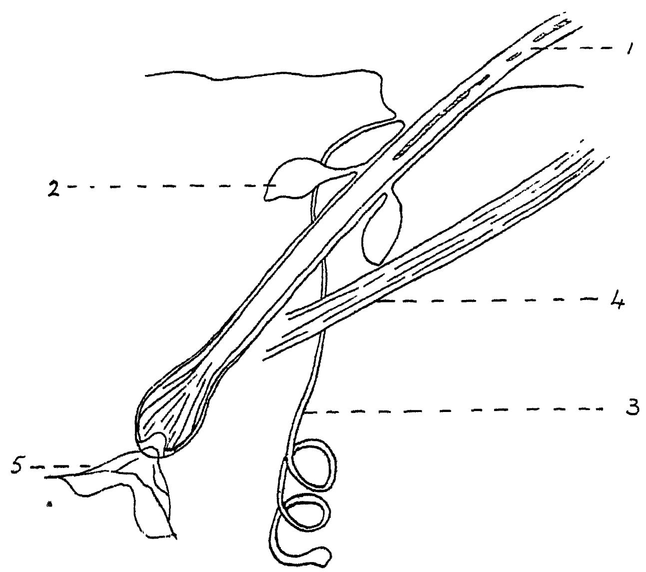

DIAGRAM OF WOOL FOLLICLE.
(1) Fibre; (2) wax-gland; (3) sweat-gland; (4) muscle; (5) blood-vessels.

work was to be an endeavour to discover what, if any, was the connection between yolk and wool on the one hand, and between yolk and feed and weather on the other hand.

The yolk as it occurs in the fleece consists of the products of two sets of glands in the sheep's skin—the sweat-glands such as are found in the human and other animal skins, and special wax-glands which have a somewhat more intimate connection with the follicle in which the wool-fibre grows. This juxtaposition of the follicle and the two types of glands would seem to indicate the probability of a connection in their function (see diagram).

The wool-fibre as it grows up from the root of the follicle is complete in its elaboration before it reaches the surface of the skin. Just before emerging from the mouth of the follicle it passes the openings of the wax-glands and receives a coating of wax. At the skin-level it emerges into a small depression into which the sweat-gland, if one be present, discharges its secretions. Thus it is seen that the fibre becomes completely covered with wax and sweat. It should be noted that though the term " wool-fat " is frequently used in referring to the product of the wax-glands, this material contains no fat, but rather resembles wax such as beeswax in its chemical composition. This composite coating is what is known as yolk. Since the yolk is applied to the outside of the already completed fibre, its function would appear to be a protective rather than a nourishing or building one.

However, a certain amount of yolk probably penetrates from the outside into the interior of the fibre by way of the pores between the cells which make up the fibre, and acts as a lubricant there as on the outside, maintaining the pliability and elasticity of the fibre([5]). These pores are not normally visible, but on extracting the fibre very thoroughly with solvents which remove the wax they become visible under the microscope. This yolk which penetrates to the interior of the fibre constitutes the greater part of that which the manufacturer leaves in the fibre after the scouring process. In addition to acting as a protective agent against light, weather, &c., the yolk on the exterior of the fibre acts as a lubricant to prevent loosening or removal of the scales by rubbing against other fibres. Such damage when it occurs results in weaknesses in the fibre and uneven dyeing. A preliminary investigation of the exact protective action of yolk on the growing fleece has been started at this College, but has not yet reached the stage at which results are available.

Wax-glands are connected with every follicle, though their numbers and size vary from follicle to follicle. Sweat-glands, however, occur with limited numbers of follicles only, the proportion of follicles thus equipped varying probably in different parts of the skin of each sheep, and certainly in the skins of different sheep. There is a suggestion from some of the biological work at the College that sweat-glands may occur only in conjunction with certain types of fibre, or with fibres which appear before a certain stage in the lamb's development. As these types of fibre play a very important part in the development of the fleece, it may well be that differences in yolk are associated with differences in type of fleece. As yet too little is known about the relations between different fibre-types and their successors in the mature fleece for us to do more than speculate on this possibility.

The sweat-glands are extremely interesting, and as yet comparatively little is known of their functions. They resemble the kidneys to some extent in their function, since they remove waste products of the body from the blood. In the event of a breakdown in the kidneys, or in certain other abnormal conditions of the body, the sweat-glands have to take over an additional part of the load. This occurs in certain human diseases, for example, and presumably therefore in the sheep also. In addition, it has been shown that the sweat-glands secrete a colouring matter resembling the substances which give urine and bile their colour. This colouring matter is responsible for the colour of

normal yolk. It is probable that by some derangement of the activity of the sweat-glands they can secrete colouring matters which permanently stain the wool, just as urine stains it, thus rendering the wool unsuitable for many purposes. In view of the maze of channels through which wool passes between buyer and clothmaker, such wool would be discounted in price even though it were ultimately to be used for some purpose for which its stain was no disadvantage. However, even if this defect in the buying system were corrected, such wool would still be debarred from some of the most profitable branches of the trade.

The wax-glands appear to be much less variable than the sweat-glands. This is probably due partly to the fact that they are special glands evolved solely for the purpose of making wax for the wool-fibre, while the sweat-glands, as accessory excretory organs, are liable to be called upon for any odd little job in the way of removing waste products from the body. The well-known use of the sweat-glands to control body temperature, by secreting moisture which evaporates from the surface of the skin and cools the body-surface, is also a variable one, as such cooling is only required when the body becomes overheated because of a high air-temperature, vigorous exercise, or feverish conditions. But, even assuming less diversity in the character of the product of the wax-glands, there is still considerable variation in secretion, at least in amount, at different times of the year and under different conditions, as has been shown by the present writer and others.

We have seen that there are differences in numbers of both wax and sweat glands in different parts of the same sheep and in different sheep. These numerical differences and differences of size will explain a great deal of the variation in amount and type of yolk. Such variations of yolk are well known to all those interested in wool, but whether these variations are in any way linked with the type of fleece or are partly responsible for the type of wool produced is not known. This is a difficult problem on which it is hoped to shed some light in the future. The difficulty of solution is increased by the fact that the same part of the same sheep under different conditions of climate, feed, health, &c., will produce yolk varying in amount and composition as widely as do two yolks from different types of fleece. Very considerable variations occur in this way from month to month, and possibly almost from day to day, so that apparently yolk is relatively easily affected by both hereditary and environmental factors. If, then, it could be shown that yolk played an important part in determining the characteristics of the wool with which it is associated, an extremely valuable method of wool improvement might be developed.

In such an event, however, there would still be difficulties to overcome. Work done at the College has shown that in certain types of fleece it is difficult even for the expert to estimate the amount of yolk present. The difficulty of estimation of yolk by sight and touch alone, as in the fleece while still on the animal, is due to several causes. The temperature of the air has an important effect, as higher temperatures make the yolk more fluid, and there is then a tendency for more yolk to cling to the fingers. The moistness of the atmosphere also has a considerable influence on the wetness of the yolk, as some of the substances in yolk have the property of absorbing large quantities of moisture from the air. Both the appearance and the feel of the yolk depend to a considerable extent on the relative proportions in which wax and

sweat are present, and the appearance is also influenced by the amount of colouring matter present. As a result of these various effects, it is desirable that some method of estimation independent of sight and touch should be used wherever possible. A satisfactory laboratory method for the estimation of yolk has been devised, and possibly if the necessity arose a suitable field test could also be devised.

In determining the actual composition of the secretions of the two types of gland, it is generally assumed that the water-soluble material is chiefly secreted by the sweat-glands, while the material insoluble in water but soluble in certain other solvents, such as ether, is produced by the wax-glands. That this broad but convenient distinction is somewhere near the truth is shown by comparison with the skin secretions of animals which have only one type of gland on the greater portion of their bodies—the human skin, for instance, having chiefly sweat-glands. The waxy portion of the yolk—the secretion of the wax-glands—consists chiefly of a substance called cholesterol and other similar substances. Cholesterol though insoluble in water readily forms an emulsion with it. Thus lanoline is an emulsion of the wax in water. The sweat, or "suint" as it is often called, is composed principally of potash compounds with certain natural acids, such as stearic acid. These compounds are soaps, and hence soluble in water. They probably aid in the emulsification of the wax, soaps being good emulsifying agents.

The relative amounts of sweat and wax vary considerably. Wax may occur to the extent of from 2 to 60 per cent. of the raw wool, while the sweat content varies from 2 to 20 per cent. The sweat commonly contains about 60 per cent. of potash. It is interesting to note that New Zealand annually exports from 4,000 to 5,000 tons of potash with the wool-clip. It is not possible to recover all this potash from the scouring-liquors. In commercial practice yields of 30 lb. of potash salts suitable for fertilizer are obtained from 1,000 lb. of raw wool. The potash as recovered commercially is mainly in the form of carbonate.

The writer has found in a fairly even Romney crossbred flock variations from 7 to 26 per cent. in sweat, and from 3 to 15 per cent. in wax content. These values all refer to the wool on the middle of the side. Variations almost as great as these occur in different parts of the same fleece, while all breeders are familiar with the phenomenon known as "rise" of the yolk. This more or less sudden appearance of heavier condition in the fleece is probably due to two factors: (1) The production of an increased amount of yolk; (2) the increased fluidity of the yolk.

There is some evidence to show that the increased production may occur some time before the "rise" becomes evident, but only becomes apparent when the yolk becomes more fluid. The increase in fluidity is due on the one hand to warmer temperature making the wax softer, and on the other hand to the amount of water absorbed by the sweat. Sweat has the property of picking up moisture from the air, so that if a dish of dried sweat is exposed to the atmosphere it will within a few hours absorb enough water to become dissolved. The temperature and moisture factors between them account for the difference in appearance and feel of yolk even on consecutive days, not only in the fleece on the sheep's back, but also in wool left in bins, where there can be no question of change in the amount of yolk present. This is also the explanation of

the difference in appearance between a long "locky" hogget fleece, in which the wool is exposed to the drying action of the wind (and to a certain extent to leaching by rain), and a closer ewe fleece, in which the maximum amount of heat and moisture is retained.

The amount of yolk actually present in a fleece under ordinary conditions represents the difference between the amount produced by the sheep's skin and that leached by rain or otherwise removed. The amount of leaching and removal by other forms of weathering is dependent on the size of staple, openness of the fleece, the efficiency of the fleece as a thatch, and the type of yolk present, even under similar conditions of weather; so that in order to obtain for experimental purposes a reliable estimate of the yolk production of the skin, protection from the weather is essential. This is doubly important, as the leaching removes a greater proportion of sweat than of wax.

The writer(4) has shown that covering with a light waterproof cover is a suitable method of protection. It is interesting that even in hot summer weather the covers did not increase the amount of yolk, but merely increased its fluidity. As a result, the appearance of the wool of the covered sheep was considerably improved, even as compared with the uncovered sheep which never got wet, and so had just as much yolk but not such a good distribution of yolk. Another difficulty arises from the variations which have been pointed out above—variations in different parts of the same fleece, in the same part of different fleeces, in the same part of the same fleece from time to time—variations which express the interworking and interdependence of an unknown number of factors of heredity and environment. In fact, the problem, dealing as it does with living animals, shares all the difficulties common to biological problems, difficulties which arise from the fact that no two animals are alike.

The solution of this puzzle involves the use of averages from large numbers of animals sampled at frequent intervals under conditions as carefully controlled as possible. With the sheep it is not possible to control environmental conditions as closely as can be done with smaller animals, nor is it possible to produce such a uniform line of animals as can be done with more rapidly breeding small animals such as guinea-pigs and rats, which are frequently used for experimental purposes. The only method is the treatment of sufficiently large numbers to give a reasonable accuracy. It is possible to calculate the accuracy of a set of results, and thus keep a check on any conclusions that may be drawn.

In spite of the long and laborious nature of the work, and the limitations due to circumstances over which the worker can have no control, stimulating and interesting results are already appearing—results which when critically examined suggest numerous and useful lines for further work.

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FEEDING OF PIGS IN DAIRY DISTRICTS.*

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WHILE much or all of what is now said may not be new, it is felt that restatement is justified. One so frequently encounters losses of pigs attributable to faulty feeding, or farmers who have become discouraged or have abandoned pig-keeping as a result of such losses, that it would seem that available information has been overlooked or disregarded.

It must, of course, be admitted that there is still much to be learned as to comparative costs of various feeding methods, comparative qualities of pork or bacon thus variously fed, and particularly as to comparative value, from the point of view of quality and economy, of different strains and first crosses of the various pure breeds. It is confidently hoped that the valuable work now being done by the Pig Recording Committees will yield this information. It should be stated here that numerous points in this article have been derived from experiments carried out by Mr. Peirson, Recording Officer for the Waikato Committee.

One general statement to be made is that it pays the farmer to breed his own pigs. Records of costs show that the weaner can be produced on the farm at a cost much less than that which has to be paid in hard cash on the market in the spring. The satisfactory profit made by those who breed and sell their weaners is also proof of this. The objections to the alternative of going on the market for weaners are several. Usually, at the time when one wants to buy weaners in readiness to deal with the surplus of skim milk or whey, a similar want is felt by all the would-be feeders at once, so that weaners bring high prices, up to as much as 25s., thus leaving a narrower margin of profit when they are turned off after three months' additional feeding. Also, there is the ever-present risk of introducing disease with market purchases, and the frequent chance that unless one has had previous experience of that breeder's pigs they may prove of unthrifty strain or defective conformation.

COMPOSITION OF FOODS.

All our common foodstuffs are combinations in various proportions of five ingredients: (1) Proteins, which are the nitrogenous and flesh-forming elements; (2) carbohydrates, the fat-forming and energy-producing substances, including starches and sugars; (3) fats, somewhat similar to carbohydrates; (4 and 5) vitamins and minerals, which are essential to life, growth, and health.

It is the variation in proportions of these five substances which, apart from digestibility, largely determines the value of the different foodstuffs in various stages of the animal's growth. The animal body calls for a wide variety of substances, and therefore, in general, a diet including a number of foodstuffs is more likely to include all the substances necessary for growth and health than a diet comprised of one foodstuff.

* Substance of a radio broadcast lecturette.

The proteins are the most complex and perhaps the most important elements, and include a greater variety, there being, for instance, at least twenty different types of protein in milk Proteins are chiefly important to young growing animals, and only little less so to pregnant and milking animals. With the trend of present fashion among flesh-eaters of the human race towards lean meat and preferably young lean meat, and away from the fat-laden bacon, mutton, and beef of the past, it would seem that protein substances must become of greater importance in the diet of young animals fed for meat.

Examples of protein-rich substances are lean meat, and therefore meat-meal; casein of milk, present in whole and skim milk; young growing grass; and certain meals such as linseed and pea-meal. Protein substances are usually expensive, and it is fortunate for the pig industry in the dairy districts of New Zealand that abundance in the form of skim milk is available during spring and summer. It is an interesting comparison with pig-feeding methods in the United States of America to note that there, with cheap grains, milk is regarded in the grain belt as a valuable supplement. In New Zealand, particularly in the North Island pig-feeding districts, milk is cheap and plentiful, and grains are used with discrimination.

Carbohydrates, present in all foods, preponderate in the tubers such as artichokes and potatoes, certain meals such as maize, and in milk sugar (in whey) and molasses. Excess of carbohydrates is stored up as fat, and it is recognized that the nature of the food can influence both amount of fat and its quality as to firmness, &c.

Fats and oils are present in minute amount in most vegetable feeds. Certain oils fed as such have feeding-value, but there is always danger in feeding animal fat or oil to pigs later to be used for bacon, because this is stored up in the body and retains any taint or odour for a considerable period to the detriment of the quality of the meat.

Minerals.—The importance of a proper supply of minerals in the diet of all animals is now generally recognized, and this applies fully to the pig. Sows' milk is particularly rich in lime, the percentage being nearly three times that of cows' milk. Definite experimental proofs have been given that shortage of calcium leads to reduced rate of growth in young pigs and to defective bone-development, and that phosphates are equally important. Definite disease attributable to calcium deficiency does not seem prevalent in New Zealand, but much of the often-seen unthriftiness in weaners may be related to some mineral deficiency. Anæmia of suckling pigs, believed due to insufficiency of iron in the mother's diet prior to farrowing, is said to be frequent in the United States, but has not been recognized here to any extent, nor is it likely to occur where the sows are pastured rather than kept in sties. While a properly balanced diet will contain sufficient minerals, if this is at all in doubt the use of small amounts of bone-flour, together with meat-meal which supplies iron and phosphorus, is advisable.

It may be reiterated that shortage of protein or mineral is less likely to occur where the diet is varied—that is, includes several types of foodstuffs. Not only this, but experiments show that the addition of a small quantity of a second foodstuff to one fed as sole diet leads to more complete digestion and utilization of the main foodstuff, and is thus economy.

Feeding the Pregnant Sow.

The production of the first crop of healthy weaners ready for the new season's dairy by-products is the farmer's aim. The first sows should farrow about the end of June, and the first young-litter sows should come along later—say, in August—and will help to fill the gap. These dates may apply more particularly to the Waikato area. Attention to feeding must commence with the sows before farrowing, and one can state in general terms that she should have sufficient protein and mineral. When a certain amount of skim milk is available this supplies protein, but considerable mortality has been observed in the litters of sows fed with plenty of skim milk and little else. Meat-meal at the rate of 1 lb. per day or less, depending on the sow's condition for a month before farrowing, has been found an excellent supplement to skim milk, or, indeed, to any winter diet.

The sow is best left with as free a range as possible. By bringing the sows in early there should be no difficulty in getting two litters a year, and of disposing of the second one before the end of the season.

Feeding and Care of the Litter.

Mortality in the baby pigs is one of the serious losses to the industry. Feeding and cleanliness will do much to reduce it. Whether the sow is farrowed in a clean grass-yard, with an open portable house, or is confined to a proper farrowing pen. will depend largely on the locality and nature of the soil, drainage, aspect, and shelter from prevailing winds. While one prefers to see the sow in a sty, nicely bedded, and the young ones snug and warm, it was observed recently in one piggery that diarrhœa was a constant trouble with the week-old piglets. Modifications of the sow's food did not appear to influence this until the method was changed and the sows farrowed in clean grass-yards. Apparently an infection in the sties was responsible. It is not, of course, intended to advocate a liberty-at-any-price system, and allow the young pigs to be trailed in mud-covered areas around ~~the cow~~-yard. The sow should be kept a little short for twenty-four hours after farrowing.

The use of the creep system, whereby by means of a hurdle across the sty or use of an adjacent sty the young pigs are allowed access to a small trough of their own, makes the weaning easy and almost automatic, and has been shown repeatedly to produce heavier piglets at eight weeks.

A scale of feeding found by the Waikato Committee's recording officer to answer well is to start with 1 oz. of meat-meal per piglet, added to a little skim milk; at three weeks old increasing to 2 oz.; and to ¼ lb. at eight weeks, by which time he is weaned. The total cost for meat-meal up to this age, including that fed to the sow before farrowing, will not exceed 1s. 10d. per pig.

As soon as the little pigs are taking the meal, the allowance which up to this time has still been fed to the sow, along with skim milk, and roots if available, is cut out. Feeding of the sow before farrowing and of the litter in the first eight weeks constitute the important factors. It has been found that whatever weight the pig is at this stage he will be two and a half times as heavy in sixteen weeks. The production of 40 lb. weaners at eight weeks has been achieved in over 50 per cent. of the litters recorded last season by the Waikato officer.

Before, and particularly after, weaning the young pigs should be fed little and often. Their troughs should be of a suitable size, and they should not be allowed to gorge themselves, or digestive troubles will result. Good-quality grazing becomes valuable at this stage, but the pigs should be in small lots of six to ten, otherwise they soil feeding places and yards. Meantime, besides the meat-meal, pollard, ¼ lb. of each, is added to the milk or whey, and this is gradually increased to ½ lb. of each at ten weeks, at which age the pigs should be about 80 lb. porkers.

Feeding of Baconer Pigs.

While the production of pork is usually the most payable proposition, it sometimes suits the farmer to carry on certain pigs to use up milk, or he may have pigs carried through the winter to fatten. One sees pigs approaching the bacon stage confined to sties, and getting skim milk or whey alone, apparently thriving and growing, though being fed in defiance of the principles here advocated. A small addition of a meal mixture—say, pollard, maize, and meat-meal—would result in much better use being made of the basal food, which would be more completely digested, and it would also mean a better quality of bacon. If the pigs have no grazing, the addition of a little green food, such as peas or clover, helps to maintain health.

Winter Feeding of Store Pigs.

The farmer may be left at the beginning of winter with a number of unfinished pigs, for which the price at that season is very small. Articles by the Live-stock Division's Instructor in Swine Husbandry have pointed out that such pigs may quite profitably be carried through on a diet of roots—artichokes, turnips, or mangels—with a little freedom of range, shelter, and ½ lb. of meat-meal per day.

A recent experiment supervised by Mr. Peirson may be quoted in illustration: Nine pigs on artichokes plus ½ lb. meat-meal per day showed a total gain of 181 lb. in fifty-six days, consuming 252 lb. of meat-meal and bone-meal. With eight pigs on artichokes alone the experiment had to be stopped at thirty days, as the pigs were losing condition and showed a loss of 36 lb. in that time. As weaners in May were worth 3s. to 4s., and stores in August were worth 35s., the cost of meal was well repaid.

Further trials recently published by the Live-stock Division show that with winter store pigs having a run on grass, plus ½ lb. meat-meal, as against a control lot getting grass and ½ lb. meat-meal and ½ lb. barley lightly crushed, the lots showed a daily gain of 0·385 lb. and 0·453 lb. respectively, and it was considered that the addition of the barley meal was not economical. In a second trial chopped ensilage (some being lucerne and some grass) was fed, just under 5 lb. per day, together with ½ lb. meat-meal and a run to grass; the ensilage was shown to have feeding value and to be relished by the pigs.

Conclusion.

It pays the farmer to breed his own pigs. Proper feeding of the sow before and after farrowing, cleanliness, and the use of the creep system will help to cut down infant-pig mortality, and will give the 40 lb. weaner, which is profitable. Variety in the diet is relished by the pig as much as by ourselves.

CONTROL OF CLUB-ROOT.

EXPERIMENTS WITH LIME AND FERTILIZERS.

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LIME has long been advocated overseas as an effective controllant of club-root, but prior to the commencement of investigations in 1928 it had failed to provide a satisfactory control in New Zealand. The work at Palmerston North has shown in both small-plot and field experiments, first, that applications of burnt lime in quantities which the farmer can afford will provide a practical control of club-root; secondly, that the value of lime as a club-root inhibitant may be lost by drilling seeds in contact with superphosphate, basic super, a mixture of super and carbonate of lime (half and half), or special turnip manures composed largely of super; and, thirdly, that to procure an effective control with lime the fertilizer applied with the seed must be of a strongly basic nature, preferably basic slag or a mixture of equal weights of super and slaked lime. It is clear that the practice of sowing seed in contact with super and special turnip manures has, in the past, obscured the value of lime in reducing the attacks of the disease.

EXPERIMENTAL EVIDENCE.

From experiments conducted at the Plant Research Station it would appear that liming may not always prevent the development of the disease, but attacks may be so reduced that the majority of plants will develop normally. Apparently time must be allowed for the lime to penetrate to the deeper layers of the soil in which the roots grow. When penetration was incomplete infections frequently occurred at a more or less uniform depth some inches below the surface of the soil. This type of infection was fairly common in soil limed two or three months before sowing the crop, while in unlimed areas practically all the plants were attacked at the level of the soil surface. The odd infections that occurred twelve months after liming were all fairly deep in the soil.

The greatest damage results when club-root infection occurs at soil-level, as the disease interferes with the transportation of foodstuffs from the roots to the aerial portions of the plant. Sometimes swede and turnip seedlings overcome infection at soil level, but a lesion remains in the skin of the bulb, permitting the entry of putrefactive bacteria which render the bulb useless. Infections at depths of several inches, however, are of less importance, as there are usually many undiseased roots by which the plant may be nourished.

When club-root developed on soil dressed twelve months previously with 1½ to 2 tons of burnt lime per acre the infection was usually of the latter type, provided the crop was sown with basic slag. When the crop was sown on similar land with super, club-root developed almost invariably within an inch of the surface, thus clearly demonstrating the disadvantage of sowing super on limed infected soil.

FIG. 1. CLUB-ROOT INFECTION ON ODD RAPE PLANTS AT DEPTH BETWEEN 9 IN. AND 12 IN. IN SOIL LIMED TWELVE MONTHS PRIOR TO SOWING THE CROP.

When to apply Lime.

The experiments have shown that lime must be applied at least three months before sowing the seed. Time must be allowed for the lime to permeate the soil in which the roots will grow. When sowings took place too soon after liming, club-root was frequently observed at depths of 2½ in., 3 in., or 4 in. below the soil surface, the depth at

FIG. 2. SOME TYPES OF INFECTION OCCURRING IN UNLIMED SOIL—FOR COMPARISON WITH FIG. 1.

which it occurred varying with the quantity applied and the lapse of time between liming and seeding. After the lime had been applied for twelve months odd plots were found where the only infections were at 9 in. or 11½ in. below the soil-level. As indicated, to obtain practical control of club-root the lime must be applied at least three months or preferably twelve months before the crop is sown. It is essential that the lime should be intimately mixed through the upper layers of the soil in which the roots will grow.

QUANTITY OF LIME TO APPLY.

The quantity of lime necessary to control club-root will probably be found to vary in different districts, but in the experiments under review effective control was obtained by dressings of 2 to 3 tons of burnt lime or freshly slaked lime per acre, applied three months before seeding. Similar control was obtained by applications of 3 to 5 tons of carbonate of lime applied at a similar period before seeding. When lime was applied twelve months in advance of sowing, satisfactory club-root control was obtained with dressings of 1 to 2 tons per acre of burnt or freshly air-slaked lime, or 2 to 3 tons per acre of water-slaked lime. Applications of 3 to 5 tons of carbonate of lime per acre were somewhat less satisfactory than the burnt lime.

In some field experiments an effective control has been obtained with 33 cwt. of burnt lime per acre, harrowed in three months before seeding. The present evidence from field experiments at both Palmerston North and Gore* would appear to indicate that 33 cwt. of burnt lime per acre applied three months before sowing is the minimum application that will effect a practical control of the disease.

SEEDING AND SELECTION OF FERTILIZER.

It is the selection of the fertilizer with which the seed is sown that largely determines whether club-root will be controlled or not by liming. Lime does not kill the spores of the club-root organism, but renders the soil environment unsuitable for their germination. The sowing of an acid fertilizer in contact with the seed may, temporarily at any rate, neutralize the effect of the lime and make the soil conditions about the seed suitable for club-root development. Fertilizers which have been found to nullify the value of the lime as a club-root controllant are super, basic super, super and carbonate of lime mixture (half and half), and turnip manures composed largely of super. To ensure club-root control by liming, therefore, these fertilizers must be avoided. Basic slag or a mixture of equal parts by weight of super and freshly slaked lime have proved satisfactory and permit the lime to control the disease.

The following table illustrates the effect of the fertilizer on the control produced by lime :—

Treatment.	Percentage of Infection.	
	Seed drilled with Basic Slag.	Seed drilled with Super.
Control—no lime	59	95
3 tons commercial ground limestone ..	22	53
3 tons superfine ground limestone ..	10	87
2 tons air-slaked lime	0	78
2 tons burnt lime	0	36
2 tons water-slaked lime	3	82

* Gore Experimental Area: Report on Work in Season 1930–31. R. B Tennent. This *Journal* for November last.

Conclusions.

From Britain we have long heard that club-root may be controlled by liming and also that the development of the disease is stimulated by superphosphates, but in New Zealand these two facts do not appear to have been considered together. In consequence the endeavours of farmers to control club-root with lime have failed through the practice of sowing super or soluble turnip manures in contact with the seed.

The experiments on which the findings here presented are based were conducted on small plots and confirmed by experiments laid down under farming conditions at both Palmerston North and Gore. In all cases it is shown that burnt lime in quantities the farmer can afford (33 cwt. to 40 cwt. per acre), applied at least three months or preferably twelve months before seeding, will control club-root, provided the effect of the lime is not neutralized by the use of an acid fertilizer when sowing the crop. Full details of the experiments are published in the *N.Z. Journal of Science and Technology*, Vol. 13, No. 2, Oct., 1931.

A STARTER PRODUCING BITTERNESS IN CHEESE.

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The flavour of Cheddar cheese can be influenced by so many factors that it is usually impossible to ascribe with certainty a single cause to any particular flavour. Various types of bacteria in the milk have been shown to induce distinct and specific flavours in the cheese, both desirable and undesirable. Typical of the undesirable types are the organisms of the colon group, which give a very marked unclean flavour to the cheese. Contaminating bacteria in starter cultures can also influence adversely the flavour of cheese. Feed flavours originally present in the milk are often evident in the immature cheese in spite of pasteurization and sometimes aeration. As the cheese matures they gradually change, in most cases, with the result that their identity is obscured.

But besides these factors, which constitute biological differences in the raw material of cheese-manufacture, it is possible to modify the flavour of cheese simply by a change in some detail of the process of manufacture. Such a change produces curd of a different nature, and, since the curd is the raw material of the ripening process, the whole course of the biochemical change which subsequently takes place may be modified. This may easily, and often does, lead to differences in flavour between cheeses made from the same milk and starter. A typical example of a change in the manufacturing process which induces differences in the cheese is a variation in acidity at any stage of the process—for example, the variations in acidity which result in the difference between characteristic Cheddar and Cheshire cheeses.

With all these separate and possibly interacting factors it is readily understandable that the causes of specific flavours are difficult to locate.

Judges of cheese frequently attempt to describe either the nature or the cause of abnormal flavours. A description of the nature is helpful to the maker in that he may from a knowledge of the milk, starter, and manufacture trace the probable cause, but it is seldom that it is possible for the judge of mature cheese to state definitely that a flavour is attributable to a specific cause unless he has a full history of the cheese. For example, metallic flavours commonly described almost certainly have no connection with contamination by metals.

Bitterness is a fault in flavour which is encountered quite frequently in cheese, and which can possibly arise from several causes. Harrison (1902) investigated a case of bitterness in cheese and showed that it was due to a torula (a yeast-like organism) which gained access to the milk on the farm and rendered the milk itself, and likewise the cheese made from it, very bitter. Hucker and Marquardt (1926) showed that the acid-liquefying cocci, a group of organisms which are thought to be present in small numbers in the udders of some cows, produce a bitter flavour in cheese followed by a softening of body. With regard to modifications in manufacture, it is well known that if milk is pasteurized at rather too high a temperature, so that a cooked flavour is evident in the curd, the cheese manufactured from it almost always develops a bitter flavour as it matures. During experimental work at this Institute it has often been noticed that some cheeses made from perfectly normal milk, not overheated during pasteurization, develop a bitter flavour at an intermediate stage in the ripening process. The bitterness subsequently disappears and the Cheddar flavour may develop normally.

The present article deals, however, with a type of bitter flavour in cheese which is evidently different from all those mentioned above. This particular bitter flavour appeared to be associated quite definitely with the use of a particular starter culture, which will be referred to as "R.B." The precise origin of the culture was unknown, but at one period it had been used in the manufacture of a prize-winning show cheese. When it was used in these experiments it had become rather weak in acid-producing power in the cheese-vat, and was being used as an example of a slow starter. It contained a variety of lactic streptococci, but no contaminating organisms so far as could be determined by examination under the microscope and growth in several media.

About 80 gallons of pasteurized milk of good bacteriological quality were divided into two equal portions which were run unto two vats. In one vat the slow starter R.B. was used, while in the other a normal starter served as a control. Both batches of milk were made into cheese. This procedure was repeated on seventeen occasions. The original idea of the experiment was to determine whether a slow starter gave better results when the proportion added to the vat was increased or when a normal amount was used and the ripening period extended. With this object in view variations in the procedure were made from day to day. The results from this aspect will be discussed in a later article. There were no abnormalities to be noted during the manufacture of the cheese beyond the above-mentioned lack of vitality of starter R.B.

The cheeses were examined when fourteen to twenty-one days old, and again when three to four months old. Some were retained in the

curing-rooms at the Massey Agricultural College experimental factory until mature, and some were shipped to London under normal conditions of transport. There were considerable variations in texture, body, and flavour, as was to be expected; but apart from these an almost constant feature of the cheeses made with the use of starter R.B. was a marked bitterness, which was present a fortnight after manufacture (the first occasion on which an examination was made), and which persisted throughout the entire period of observation. This was true even in those experiments in which by the use of large amounts of culture, or by a prolonged ripening period, starter R.B. had been induced to yield the same acidity in the whey as occurred in the control vat at the time of salting.

A review of the remarks of the graders on the cheeses revealed the fact that in eleven out of the seventeen occasions a marked bitterness distinguished the R.B. cheese from the controls. Possibly it was present to a lesser extent on some of the other six occasions, although it was not specifically mentioned. The bitterness was much more pronounced than that which may develop in normal cheeses, and did not disappear as the cheese ripened. In the fourteen-day grading, cheeses made with the use of starter R.B. were awarded on the average two points less than the controls in the figure for flavour, mainly on account of the bitterness. The remarks which had been noted daily on the starter cultures at the time of addition to the vat were reviewed, and it was found that on many occasions starter R B. had shown a metallic or bitter flavour. Metallic flavours are, however, commonly detected in starters of low acidity, and are not necessarily correlated with bitter flavour in the cheese.

It was at first considered possible that lack of vitality in starter R.B. might have led to a somewhat abnormal series of events in the process of ripening, but this explanation was discounted when in a further series of comparisons between a normal starter and another slow starter no bitterness was detected in the cheese.

Several streptococci were isolated from starter R.B., and are still being examined in an investigation on the bacteriological aspects of cheese-ripening. A more complete knowledge of the biochemical characteristics of the several organisms may therefore throw more light on the mechanism of the production of the bitter flavour. There appear to be no strains in starter R.B. which will cause liquefaction of gelatine, so that abnormal proteolytic power of that type can be ruled out in a consideration of explanations of the phenomenon. It appears to be definitely established, however, that the mixture of streptococci in starter R.B. was capable of producing a bitter flavour in cheese, although it may be stated from general experience that not all "slow" starters nor all starters having a metallic flavour will produce bitterness in the cheese.

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PINK-ROT OF WOOL.

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IN this *Journal* for April last, under the title of "Two Occasional Defects in Wool," a record was made of a weak or rotten condition of wool sometimes met with in the fleeces of living sheep. As the subject proved one of some interest in certain quarters it has since been followed up at the Massey Agricultural College as opportunity offered, and the progress of the investigation is here set out.

Of the wool samples received for examination from various localities an appreciable number showed pink-rot in various stages, the condition appearing in both Romney and Merino wool. A report received that last season one particular clip had yielded three bales of affected wool is worthy of note.

The pinkness often accompanying the condition is one of the most striking features of pink-rot, but this tint may be mingled with light yellow or other light shades, or may be very pale or even entirely absent. The contraction or flattening of the wool locks in bands at affected levels, and the matting or clogging together of fibres in masses in such places, as if by some foreign substance, are other prominent features of pink-rot. This character is well shown in the accompanying photograph at the points marked, but, although a very common character, it may not be pronounced in the early stages.

The rottenness of the fibres is the worst feature of advanced pink-rot. In the early stages, however, the fibres are merely weak, and microscopic examination may be necessary for a satisfactory determination.

CAUSE OF PINK-ROT.

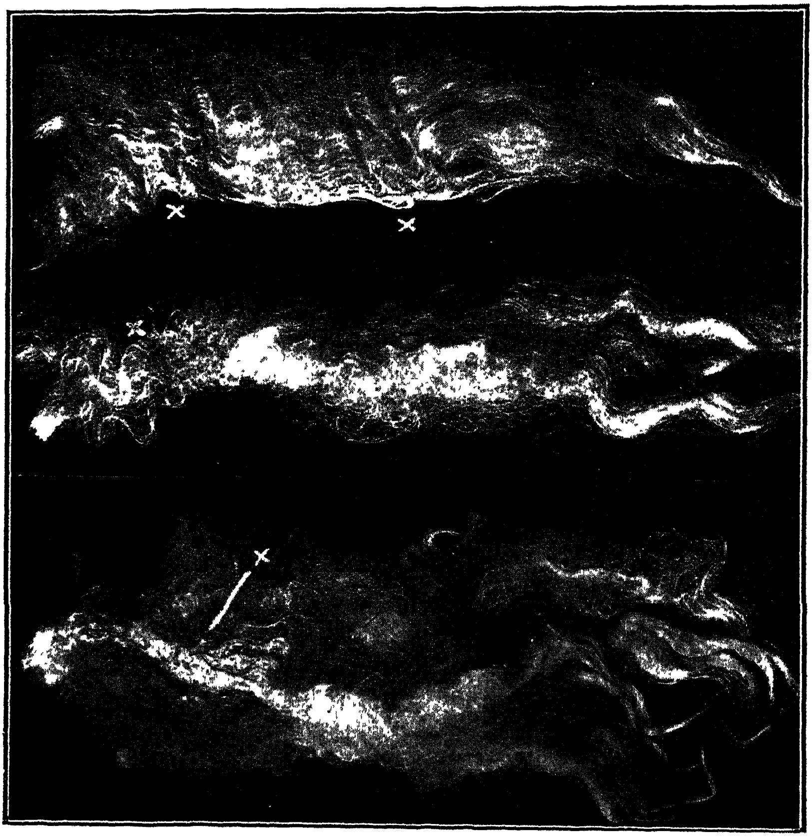
Pink-rot has been shown to arise as the result of bacterial activity. A bacterium has been isolated from pink-rotted wool and pure cultures of it repeatedly applied to good sound locks of Romney and other wool.

The wool was placed in covered glass dishes and the bacterium added, together with a little liquid food material in which it could multiply, the whole being incubated at 30° centigrade. The results of such experiments have been uniformly successful. In four days the wool shows microscopic signs of rotting (or "retting"); it becomes opaque, indicating the penetration into the fibres of bacterial products. In ten days the fibres become dull and chalky in appearance, with little or no strength left. When handled wet the fibres fall into masses of the cells of which they are composed. On drying this material clogs together in a manner characteristic of dried pink-rot found on the living sheep. The organism may readily be recovered from such material. If, moreover, the wool and food materials are incubated without the addition of the bacterium, then the wool develops no signs of the pink-rot condition.

It has therefore been clearly demonstrated that pink-rot can be produced by this bacterium. There are indications, however, that this is not the only bacterium that can disintegrate wool, and it is unlikely that any bacterium can do so except under certain extreme

conditions. On the other hand, it is probable that organisms capable of disintegrating wool are fairly common in the fleeces of sheep, and that, granted the requisite conditions, they are liable to become active and produce their effects.

Pink-rot does not typically affect the tips of locks, although it is sometimes found in that position. It is therefore not to be



LOCKS OF ROMNEY WOOL SHOWING AT THE POINTS MARKED THE CLOGGED OR MATTED CONDITION CHARACTERISTIC OF ADVANCED PINK-ROT.

[*Photo by H. Drake.*

confused with the pinkish condition sometimes occurring at the tips. The conditions favouring the development of bacteria in the fleece occur most commonly at or near the skin, although subsequent growth may carry the damaged zone outward. The temperature at the skin is only slightly greater than the optimum temperature for the growth of the isolated causative organism. If, therefore, under unusual circumstances, water should penetrate to the skin and the wool

there remain wet for a week or more, then it appears that if the organism is present pink-rot is liable to commence. It was noted, for instance, that some of the sheep that had been covered for certain experimental purposes were, in usually long spells of continuous wet weather, affected by pink-rot at the points where the bands securing the covers held the wet fleeces of the exposed sides and bellies close to the skin. These waterproof covers served in some cases to conduct rainwater to the sides, and the bands would hinder the drying-out of the fleece and hold it close to the warm skin, thus providing conditions favouring bacterial activity.

Pink-rot was also met with in cases where the fleece on the back had failed to keep out the weather. In some instances, however, the wool on the back itself, though badly weathered, was unaffected, but the rot was to be found down the sides near the skin in tracks where the water had drained through the fleece and there persisted for a greater length of time.

The Causative Organism.

Turning now to the more technical side of this subject, there are two matters concerning which records should be made :—

(1) The isolated causative organism promises to be a very convenient agent to employ in the study of the cellular structure and composition of the wool fibre. The organism appears to have little or no disintegrating effect upon the cells themselves, but rather to dissolve or soften some substance that normally holds the cells very firmly together. Advantage is therefore being taken of this in a study of the wool of our different breeds and of the structure of different fibre types. Moreover, "retted" wool is being sent abroad to ascertain its value in the study of the molecular structure of wool. The fact that wool can thus be reduced to such a finely divided condition by bacterial agency naturally suggests the possibility of utilizing this principle for some industrial purpose. This, however, is an unexplored field, although it has been ascertained that disintegrated wool may be reunited by moderate pressure and heat and made up, for example, into thin sheets of strong material.

(2) The isolated organism is a spore-bearing, gram positive, peritrichous rod capable of decomposing certain protein substances, and therefore belongs to the family Bacillaceae.* It is decidedly aerobic, and is saprophytic and gelatin liquefying; it forms rhizoid colonies, but does not greatly change its form at sporulation. Hence it falls in the genus Bacillus. It is definitely mesophilic and motile, and its spores are central to eccentric. It is deemed to fall among those "not *distinctly* swollen at sporulation," exhibits a white or cream-white pigment on nutrient gelatin, nutrient agar and potato, appears to be a very feeble liquefier of blood serum and to lack the brownish colour on potato. This suggests *vulgatus* as the species with which it coincides, and it will be seen that the two have many characters in common. Its optimum temperature is 30° centigrade; it produces acid in dextrose and sucrose, does not reduce nitrates, forms no indol, and corresponds with *vulgatus* fairly closely in its potato, broth, agar slope, and gelatin stab characters. However,

* Bergey's Manual of Determinative Bacteriology.

it softly coagulates milk before peptonizing it, and the short descriptions of the gelatin and agar colonies of *B. vulgatus* do not adequately cover the characters of the organism in question. The suggestion, therefore, that the organism is a variety of the species *vulgatus* must be received tentatively. Type cultures are being secured for comparison in various respects not mentioned above, including those relating to the action of the two organisms upon wool.

BIENNIAL BEARING IN APPLE TREES.

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BIENNIAL bearing is a problem which affects not only the New Zealand fruitgrower, but is experienced in all countries where fruit is grown. It is not only confined to apples, practically all fruits being subject in some degree to this habit of bearing a heavy crop in one season and a light crop in the following. In this article, however, it is proposed to deal only with the problem as it affects apples. Although the question is receiving world-wide attention, and considerable thought is being given to it by many research workers, no definite remedy applicable to all countries has been secured. However, valuable observations have been recorded from time to time, and many points have emerged which may be of assistance to the orchardist in studying the question.

The problem is inclined to slip past the notice of the majority with nothing more than a passing thought being paid to it. It is not because the grower does not consider it important or realize its seriousness, but often because he has come to regard this biennial bearing habit as pure " contrariness " on the part of the tree and quite beyond his control. That this habit can be gradually corrected is the opinion of most of the leading research workers who have studied the question, and many experiments are being carried out in different countries with this end in view.

The disadvantages suffered by the grower as a result of this " on-and-off " habit of bearing may be briefly summed up as follows :—

(1) The heavy crops carried in the " on " year causing an over-supply and dislocating the markets, with consequent difficulty in selling and resultant low prices.

(2) Loss in economic handling, due to equipment and organizations which are required to handle the crops in the years of heavy bearing being run under capacity in the years of short crops.

(3) Difficulty in stabilizing markets, both local and export, due to fluctuating quantities received each year.

(4) Difficulty in arranging for adequate supplies for packing and the necessary shipping and cool-storage space, due again to fluctuating quantities.

The advantages which would accrue could a uniform average crop be secured each year can be very well imagined. The whole work of the harvesting and marketing of the crop would then be made very much simpler and cheaper, and a much more stable average price should be obtained.

Biennial bearing must not be confused with the case of the irregularly cropping tree. Irregular cropping is often caused by poor nutrition, through a lack of sufficient manures, &c.; or following a year of heavy crops together with drought conditions; or, again, through unfavourable weather conditions at the time of setting. This is only temporary, as exceptionally short crops may only occur at long intervals. Irregular croppers, however, may at times become biennial bearers, through some agency which seriously disorganizes the internal processes of the tree. Further, must be kept separate the case of the unfruitful type of tree, caused by faulty pollination and lack of sufficient suitable varieties in close proximity to carry out cross-pollination. The true biennial bearer regularly crops heavily only every second year, the intervening years being marked by short crops.

It would appear that certain varieties are by nature more or less biennial bearers and are very easily thrown into such a state. Others, again, are thrown into this state by severe unfavourable conditions, which seriously disorganize the internal workings of the tree in any one year. In New Zealand probably the variety Dunn's Favourite is the most outstanding example of the naturally inclined biennial bearer; while Dougherty, Cox's Orange, and Ballarat are easily thrown into this bad habit. It is usually noticeable that spur-bearers are more easily upset and thrown into biennial bearing than those varieties which are lateral bearers.

While the tree may be thrown into a state of biennial bearing through unfavourable circumstances in one season, the process of restoring it to its natural bearing state cannot be accomplished at once or in one season. It would appear to be a gradual process, which cannot be unduly hurried by the adoption of drastic measures. More likely the adoption of such measures would lead to further disorders in the functions of the tree.

The cycle of biennial bearing is usually due to the fact that in the heavy year, owing to the demands made by the growing crop, there is little surplus food available for blossom-bud development, and consequently there is but a small blossoming the next season. Conversely, during the light year there is but a small growing crop, and there is a large surplus of food available for blossom-bud development, with a resultant heavy blossoming the following season; and so the cycle continues.

Practically all orchardists will be well aware of the fact that the blossom which appears in the spring was determined in the previous season; that is to say, the blossom-buds—from which the blossom developed—were formed during the previous season. Research workers have determined that the young growing bud commences to develop into a leaf-bud or a blossom-bud in late spring or early summer—as early as November in this country. It is considered that the determining factor in deciding in which direction a bud develops is the balance between the carbohydrates and nitrogen compounds at that time. Prominent workers consider that where the balance is in favour of carbohydrates blossom-bud development is favoured. On the other hand, if the balance is in favour of nitrogen, then leaf-bud formation will predominate.

In the years of light crops there is an abundance of leafage in the spring; far more leaf area is available than is required for elaborating

food for the setting and growing of the crop. Carbohydrates, which are manufactured by the leaves, are produced profusely, with the result that a large proportion of the young buds become blossom-buds. Thus in the following year there are heavy blossomings and settings.

In the years of heavy crops there is abundant blossom in the spring, but very little leafage. It has been calculated that in the heavy years there may be up to 50 per cent. less leafage than in the light years. With this great shortage in the leaf area practically all carbohydrates elaborated are absorbed by the setting and growing of the fruit. There is then practically no surplus available for blossom-bud formation, and so in the following spring a sparse blooming is experienced.

The whole question appears to be largely governed by leaf area, and attention should be focused on the matter of securing more uniform leafage each year. The first step must be to secure in the heavy year sufficient leaves in the early part of the season to provide an excess of carbohydrates above the amount required for setting and growing the crop, so that normal blossom-bud development may take place. The importance lies in securing the leafage early. If, as already stated, the destiny of the young bud is determined during or about November, the importance of sufficient early leafage can readily be seen, as if the required amount of leafage is not secured until December or later it is of little use.

A review of the methods which have been tried in the attempt to overcome the biennial bearing habit lead one to suggest pruning and manuring as being the most likely ones from which to secure beneficial results. Blossom-thinning has been tried with very satisfactory results in most cases. This is carried out in the heavy year when the blossoms open, and a drastic reduction is made in the number of blossoms. While this has proved satisfactory from the point of view of results, it is open to the objection of cost. Considerable time and labour have to be expended if the work is to be done thoroughly, and for that reason it is not intended here to include it as a suitable means of relief. It may be practised, however, to a limited degree in conjunction with pruning and manuring.

No advantage can be secured from thinning the fruit in the heavy year, so far as blossom-bud development is concerned. As the determining factor of the bud occurs during November, thinning the fruit is of no assistance unless completed at the beginning of November. Thinning the fruit is, of course, advantageous to the remaining fruits, and for the later storing of carbohydrates in the tree; it is, however, too late to be of material benefit for blossom-bud development.

Pruning must be carried out in conjunction with manuring to secure the best results. Pruning to secure relief from biennial bearing has two aims: one is to secure greater leaf-growth in the spring of the heavy year, and the other is to restrict blossoming in the same year.

It has already been mentioned that spur-bearers more readily become biennial croppers, and it is certainly more difficult to keep them in uniform bearing than the lateral-bearing type. Wherever possible, lateral growth should be encouraged on spur-bearers. The trees should be heavily spur-pruned the winter prior to the heavy

year, and all old clusters of spurs severely reduced and thinned out. This not only greatly reduces the blossom in the heavy year, but assists in producing lateral growth as well. The following winter those laterals which have formed should be cut back to induce further lateral growth during the ensuing light season. The next winter—that is, preceding the heavy year—these laterals should be left uncut, so as to form blossom-buds, which will bloom during the following light year.

With lateral bearers old weak laterals should be removed each year, and new laterals encouraged, which should be shortened in the winter preceding the light year, and left uncut in the winter preceding the heavy year. In the winter preceding the heavy year blossom-spurs should be well thinned out to reduce the amount of blossom.

Broadly speaking, the idea is to promote extensive lateral growth during the first light year, which growth is then left uncut, so that blossom-buds may be formed on the laterals during the heavy year for blossoming the following light year. Preceding the first heavy year the spurs should be well thinned, and the blossom heavily restricted, so that blossom-buds may be formed on the uncut laterals.

By leaving the laterals uncut preceding the heavy year they produce the leafage which is required during the early spring of the heavy year to elaborate carbohydrates for blossom-bud development.

Any manuring carried out should be an adjunct to pruning. The application of a nitrogenous fertilizer, such as sulphate of ammonia, in the early spring of the light year is recommended as an aid to the setting of the fruits. A further dressing of sulphate of ammonia is recommended to be given during blossoming, so that leaf-growth will be favoured by swinging the carbohydrate-nitrogen balance in favour of nitrogen, which favours leaf-bud and not blossom-bud formation at the critical period during November. During the spring of the heavy year no nitrogenous manures should be given, thus retarding setting and also tending to leave the carbohydrate-nitrogen balance in favour of carbohydrates, thus aiding blossom-bud formation. Although only nitrogenous fertilizers have been mentioned, it must be understood that normal applications of phosphates and potash should always be given.

It must be realized that results cannot be secured in one season, although in the third or fourth season it is reasonable to expect to observe an improvement. Normal pruning and manuring can then be gradually resorted to as the trees revert to regular normal annual bearing.

PACKING PASSION-FRUIT FOR MARKET.

INQUIRIES have been received as to the best method of packing passion-fruit for the market. Various-sized fruit-cases are sometimes used, but by far the most popular and suitable is one measuring 15½ in. by 12 in. by 4½ in. inside measurement. In this case the fruit packs snugly as a three-tier pocket pack, carrying about twelve dozen fruit, and weighing about 12 lb. As regards the stage of maturity for packing, the fruit should be ripe, but without any appearance of shrivelling.—*Horticulture Division.*

CORTICIUM DISEASE OF POTATOES.

III. LABORATORY AND FIELD METHODS FOR TESTING THE EFFICIENCY OF SEED TREATMENTS.

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POTATO plants may become infected with corticium disease either from sclerotia on the parent sets or from the fungus in the soil. Since in many cases the fungus may not be present in the soil, and most lines contain a high percentage of tubers carrying corticium sclerotia, control measures have been practically confined to seed-treatment.

Seed-treatment for corticium has been recommended ever since it was recognized that the disease was liable to cause a reduction in the yield of potato crops. The two treatments first to come into general use were one to two hour soaks in solutions of corrosive sublimate or of formalin. The strengths of solutions usually used were 1 part corrosive sublimate to 1,000 parts water, or 1 part formalin to 240 parts water. The long soak in cold formalin proved to be unsatisfactory in controlling corticium, and a short two to five minute dip in 1–120 formalin solution at about 125° F. was devised, and gradually took the place of the old method. A short dip in hot corrosive sublimate has been tested, but has not come into general use.

Up to the year 1925 the two treatments still in use were the cold corrosive sublimate soak and the hot formalin dip, but during that year two new treatments were recommended. The first was the use of organic mercury compounds which were recommended in both Germany and the United States, and the second was the acidulated corrosive sublimate treatment. Manufacturers have since then produced a large number of organic mercury compounds, but they have not yet successfully displaced the old corrosive sublimate or formalin methods.

LABORATORY METHODS.

In testing new treatments it is not always convenient to wait until field trials are carried out before the value of the treatments in controlling corticium can be known. Hence it is usual to test new treatments in the laboratory. The tubers bearing the sclerotia are treated, allowed to dry, and then the sclerotia are removed by means of a sterile scalpel. The sclerotia are thoroughly washed in sterile water and then transferred to petri dishes of potato dextrose agar, which are placed in an incubator at 21° C. Some of the sclerotia usually begin to germinate by the end of the second day, and all those not killed by the treatment are growing by the fifth day. If the petri dishes are kept for a week, one may be quite sure that growth is complete. By using this method of testing, the results of the efficiency of a treatment are obtained within a week. Thus a preliminary series is readily carried out, and subsequent series may be planned from the results obtained.

CORROSIVE SUBLIMATE TREATMENTS.

The efficiency of the old standard corrosive sublimate treatment which was generally employed by the earlier research workers in dealing with the corticium problem has been tested a number of times in the laboratory. There is, however, no consistent agreement in the results obtained, as may be seen from Table 1.

Table 1.

Name of Worker.	Year.	Strength of Corrosive Sublimate.	Length of Dip in Minutes.	Number of Sclerotia plated.	Percentage of Sclerotia which grew.
Glover	1913	1–1,000	90	100	0
Melhus and Gilman	1921	1–1,000	90	200	10·5
Thurston ..	1921	1–1,000	5	60	0
Thurston ..	1921	1–1,000	30	130	0
Thurston ..	1921	1–1,000	120	100	0
Cunningham ..	1925	1–1,000	90	15	6·7
White	1928	1–1,000	120	2,525	5·0
Chamberlain ..	1931	1–1,000	90	30	6·7
Chamberlain ..	1931	1–1,000	120	30	3·3

It is possible that some workers in making their 1–1,000 corrosive sublimate solution for treatment may have used the ordinary concentrated laboratory solution, which is made up with hydrochloric acid. This would lead to increased efficiency of treatment, and might explain the discrepancies in the results.

ACIDULATED CORROSIVE SUBLIMATE TREATMENTS.

The acidulated corrosive sublimate treatment for the control of corticium was devised by Cunningham (1925). As a result of an extensive series of experiments he recommended two treatments: (1) Overnight treatment—a sixteen-hour soak in a solution of 1–10–10,000* acidulated corrosive sublimate; (2) five-minute treatment—a five-minute dip in a solution of 1–10–1,500 acidulated corrosive sublimate.

Both these treatments gave complete control according to laboratory tests. The failure of these methods to give control in the field trials led to the publication of a further article by Cunningham and Neill (1926). In this article farmers were advised not to use the acidulated corrosive sublimate treatment until further work had been done on that method. Although no further publications have been made since then, the experiments were continued, and as a result this Laboratory has been recommending a one-hour-and-a-half soak in a 1–6·6–1,000 solution of acidulated corrosive sublimate. The idea of adding acid to corrosive sublimate solutions has been taken up by several American research workers, and Leach, Johnson, and Parson (1929) found that a five-minute dip in a 1–5–500 acidulated corrosive sublimate solution was more effective in controlling corticium than the standard 1–1,000 corrosive sublimate two-hour soak.

* 1–10–10,000 signifies 1 part corrosive sublimate, 10 parts hydrochloric acid, and 10,000 parts water.

TREATMENTS EXTENDING OVER TWO YEARS AT THE PLANT RESEARCH STATION.

During the winter of 1929 an attempt was made to evolve an improved method for corticium control. Since such promising results had been obtained by Cunningham's initial experiments with acidulated corrosive sublimate, this method was the first to be studied. The addition of hydrochloric acid to a solution of corrosive sublimate definitely increases the fungicidal properties of the solution, and a theoretical consideration of the problem suggested that the increased toxicity might be due to the ionization of the corrosive sublimate. If this were so, then the addition of an equivalent amount of a chloride to the solution should bring about the same result. In order to test this theory a series of treatments was planned, and the scheme of the experiment and the results may be seen in the following table :—

Table 2.

Solution.	Length of Soak in Minutes.							Control.
	15.	30.	45.	60.	75.	90.	120.	
1-1,000 corrosive sublimate ..	46·7	43·3	26·7	10	10	6·7	3·3	..
1–6·6–1,000 acidulated corrosive sublimate	0	0	0	0	6·7	0	3·3	86·7
1–3·4–1,000 corrosive sublimate plus sodium chloride	33·3	33·3	3·3	10	16·7	16·7	6·7	..

The figures given in the table represent the percentage of sclerotia which grew. There were thirty sclerotia plated in each treatment and sixty in the control.

The amounts of acid and salt added to the corrosive sublimate solutions in this experiment were such as to bring about ionization to the same extent. The results show that the addition of salt makes little or no difference to the fungicidal properties of the solution, so that it is clear that ionization is not responsible for the increased toxicity. This being the case, it seems probable that the addition of hydrochloric acid might bring about an increased penetration by some physical means. In an attempt to bring about a still greater penetration of the sclerotia an experiment was set out in which varying amounts of alcohol were added to acidulated corrosive sublimate solutions. The object of adding alcohol was to lower the viscosity of the solution.

In order to produce only partial killing of the sclerotia a 1–10–4,000 acidulated corrosive sublimate solution was used, and to portions of this were added 0, 2, 4, and 8 per cent. of alcohol respectively. A thirty-minute and a ninety-minute dip were employed, and twenty-five sclerotia from each treatment were cultured on potato dextrose agar. The alcohol had no noticeable influence on the toxicity of the acidulated corrosive sublimate solution, so it was concluded that the alcohol did not bring about any increased penetration.

In testing three organic mercury disinfectants—Semesan Bel, No. 664, and Cal-K made by the E. I. du Pont de Nemours and Co.—Cal-K proved to be the best fungicide. Cal-K is recommended for use

as an instantaneous dip, but a series of experiments were carried out in which both short-time dips and pre-soaks were included, the results being as follows :—

Table 3.

Solution.	Time Length of Dip.	Cold Water Pre-soak.	Number of Sclerotia plated.	Percentage of Sclerotia which grew.
Control ..	..	..	50	92
Cal-K 1–40 ..	Instantaneous	..	50	70
Cal-K. 1–40 ..	5 minutes	..	50	0
Cal-K. 1–40 ..	10 minutes	..	50	0
Cal-K. 1–40 ..	Instantaneous	3 days	50	66
Cal-K. 1–40 ..	Instantaneous	6 days	50	62

The pre-soak in this instance consisted of dipping the tubers in cold water and then covering with a wet sack which was kept wet throughout the experiment. The results show that the pre-soak was of little value. Although the five- and ten-minute dips looked promising, it was discovered that when the five-minute treatment was used in the field it was too severe on the tubers. Thus in an experiment where one hundred control and one hundred treated tubers were planted the germination results at the end of thirty-two days were: Control, 96 per cent. growing ; treated, 27 per cent. growing.

CONTROL OF CORTICIUM IN THE FIELD.

In the 1929–30 season a series of corticium control trials was carried out, using three different organic mercury disinfectants and the standard acidulated corrosive sublimate treatment. These treatments were tested in the laboratory, and both laboratory and field results are given in the following table :—

Table 4.

Treatment.	Strength of Solution.	Time Length of Dip.	Laboratory Results.		Field Results.	
			Number of Sclerotia.	Percentage which grew.	Number of Sets.	Percentage infected.
Control ..	..	..	50	48	125	70
Acidulated corrosive sublimate	1–6·6–1,000	1½ hours	50	0	300	11
Cal-K ..	1–40	Instantaneous	50	12	100	25
No. 664 ..	1–68	1 minute	50	38	100	34
Semesan Bel	1–10	Instantaneous	50	32	100	71

Several workers, as for example Schander and Richter (1924) and Cunningham and Neill (1926), noticed that although a treatment gave complete control according to laboratory methods it did not do so when tested in the field. The same difficulties have been met with in the present experiments. Out of 180 sclerotia taken from the tubers which have been treated by the standard method—1-6·6-1,000 acidulated corrosive sublimate one-hour-and-a-half soak and plated on to

potato dextrose agar—not one has grown. The results of the 1929–30 trials in Table 4 show that in the field this treatment gave 11 per cent. of infection.

A series of experiments was planned for the 1930–31 season to test further treatments for control of corticium and to gain further information concerning discrepancies between laboratory and field control. Results are given in Table 5. No laboratory tests were made of these treatments.

Table 5.

Type of Set.	Percentage of Tuber Infection.	Treatment.	Strength of Solution.	Time Length of Dip.	Number of Sets planted.	Percentage of Infection.
Seed ..	0	Control ..	..	..	300	2·3
Seed ..	0	Acidulated corrosive sublimate	1–6·6–1,000	1½ hours	100	2
Seed ..	100	Control ..	..	..	100	73
Seed ..	100	Corrosive sublimate	1–1,000	2 hours	100	13
Seed ..	100	Acidulated corrosive sublimate	1–6·6–1,000	1½ hours	100	12
Seed ..	100	Ditto	1–10–500	5 minutes	100	12
Seed ..	100	,, ...	1–10–500	20 minutes	100	9
Seed ..	100	,, ...	1–10–500	1½ hours	100	5
Cut table	100	Control ..	..	..	200	52·5
Cut table	100	Acidulated corrosive sublimate	1–6·6–500	1 hour	100	10
Cut table	100	Ditto	1–6·6–600	1 hour	100	7
Cut table	100	,, ...	1–6·6–800	1½ hours	100	13
Cut table	100	,, ...	1–10–700	1 hour	100	7

Again treatment by the standard method failed to give a satisfactory control. There are three possible explanations as to why the treatment did not give complete control in the field.

(1) The soil may have been infected with the corticium fungus, in which case reinfection might have occurred. In the case of the 1930–31 trials, the plots were so arranged that each treatment should have equal chances of infection. Under these circumstances, if the 12 per cent. infection occurring in the standard treatment line were to be put down to soil contamination, it would be difficult to explain why both the treated and untreated picked clean seed should show only 2 per cent. and 2·3 per cent. infection respectively. Also the treatments which are stronger than the standard treatments show a better field control. It is therefore improbable that the 12 per cent. infection shown by the treatment in 1930–31 can be explained by soil contamination alone.

(2) The fungus may have spread from adjacent rows during cultivation. Corticium does spread from plant to plant within a row (Chamberlain, 1931) and it is probable that a certain amount of spread has taken place in this way. Although there is no available evidence on the subject it is possible that a small percentage of infection may take place between one row and another. The infection of both the treated and untreated picked corticium-free seed might possibly be explained by this means. This is partly borne out by the fact that

ninety tubers of the same treated picked seed sown on a different part of the farm, away from other potatoes and in soil which had not grown a previous crop of potatoes, showed no infection at harvesting. However, the higher percentage occurring in the standard treatment cannot be entirely due to this cause.

(3) Some of the sclerotia, none of which grew on potato dextrose agar in the laboratory, may have grown under the conditions existing in the soil. This is possible, since neither soil infection nor spread of the fungus from adjacent rows adequately explains the degree of field infection occurring in potatoes treated by the standard method.

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INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 19th November to 17th December, 1931, include the following of agricultural interest:—

No. 65501: Hay-sweep; W. H. Franks. No. 65564: Fibre-treatment; J. van Boss. No. 66379: Fleece-deburring machine; R. Vicars. No. 67441: Farm roller; S. R. Duxfield. No. 67777: Grab for hay-stacker; D. McL. Wallace, Ltd. No. 67792: Fibres from plant-stalks; G. A. Lowry. No. 67813: Harrow; S. Doxey. No. 65594: Cover for stacks; W. Hutchinson. No. 65939: Knapsack sprayer; A. E. Grigg. No. 66058: Chicken-brooder; H. F. Rose. No. 66219: Teat-cup; W. McEwen. No. 66335: Protector and wire supports for fruit-trees; M. Davey. No. 66649: Cheese-press hoop; G. L. Noble and J. Simmons. No. 67839: Treating hard vegetable fibrous material; R. D. Coghill. No. 65689: Potato-sower; W. H. Barber. No. 65724: Cheese-vat; R. W. Currin. No. 65761: Administering pills to animals. No. 66031: Drenching horn; C. W Pierson. No. 66207: Hay-sweep; W. D. Ross. No. 66359: Milking-machine; J. G. Henderson. No. 66362: Milking-machine; J. S. Read. No. 66537: Manure-distributor; J. Macalister. No. 67493: Phosphatic fertilizer; Oberphos Company. No. 67908: Hay-grab; H. V. Henrikson.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

POTATO-MANURING EXPERIMENTS IN THE SOUTH ISLAND.

SUMMARY OF EFFECTS OF MANURES OVER SIX SEASONS, 1925-26 TO 1930-31.

Fields Division, Department of Agriculture.

THE salient features of the results of sixty-seven experiments which have been carried out by the Fields Division during the past six seasons are here presented, and the effects on yield of superphosphate, sulphate of potash, sulphate of ammonia, and two ammonium phosphates are analysed. A summary of the findings, together with recommendations to farmers based on the latter, was published in this *Journal* for September, 1931.*

An outline of the methods employed in conducting potato-manuring experiments was published in the *Journal* for July, 1926. The only modifications since that time have been in method of applying fertilizers and in the sizes of plots. Hand application in the row with the sets has proved most accurate and least laborious, and has been adopted generally.

In the 1930–31 season single-row plots were adopted instead of the three-row plots previously used. This enabled greater replication with a reduction in area for each experiment to be effected without loss of accuracy. Work conducted in 1930–31 indicated that the effect of fertilizer in one row on the yield of plants in the adjoining row was negligible—with one exception, which need not be discussed here. Consequently, it was considered that the reduction in the number of rows per plot was justified. Plots were replicated from six to twenty times in the various experiments. Statistical examination of results has been carried out by "Student's" method in most cases.

Up to and including the 1927–28 season experiments were confined to North, Mid-, and South Canterbury. In 1928–29 and subsequently they were extended to Marlborough (1928–29 only), South Otago, and Southland. A list of co-operating farmers, showing the locations of experiments, is appended to this article. The numbers allocated to the different experiments are shown opposite the names of the farmers who co-operated in each of the seasons 1925–26 to 1930–31 inclusive.

OBJECTS OF THE EXPERIMENTS.

The objects of the experiments were :—

(*a*) To determine the effect of superphosphate when used alone, at 3 cwt., 5 cwt., and 7 cwt. per acre. It was assumed that 3 cwt. per acre was a good paying quantity to use, under Canterbury conditions at least.

(*b*) To determine the effect of using sulphate of potash and sulphate of ammonia, singly and together, each at 1 cwt. per acre, as adjuncts to superphosphate at 3 cwt. per acre.

* The summary indicated that the results of fifty-six experiments conducted in 1927–28 to 1930–31 inclusive would be presented. Space does not permit of the publication of detailed results, however, and differences between treatments only are shown in the tables. The analyses of yield differences are made from sixty-seven experiments, not sixty-three as stated in the summary.

(*c*) A few experiments were conducted to determine how ammonium phosphates, such as Ammophos and Diammonphos, compared with a mixture of super and sulphate of ammonia containing the same quantities of phosphoric anhydride and nitrogen.

(*d*) The effect of using sulphur in addition to a complete phosphate-potash-nitrogen fertilizer was also investigated in three experiments.

Evaluation of Increases due to Manure.

The economic values of increases due to various fertilizers are discussed in the comments following Tables 1, 2, 3, and 4. The following "round figure" values are allocated to potatoes and fertilizers: Table potatoes, £3 per ton (in the ground); seed potatoes, £1 10s. per ton (in the ground); superphosphate, 5s. per cwt.; sulphate of potash, 15s. per cwt.; sulphate of ammonia, 12s. per cwt. The value for potatoes represents their approximate average market values (£4 10s. for table and £3 for seed tubers), less per-ton charges for digging, bagging, cartage, &c., estimated at about £1 10s. On account of fluctuations in market prices and marketing costs it is impossible to state a definite value for potatoes. The costs of landing fertilizers on the farm and applying them will also vary, so "round figure" costs ex store are taken.

Treatments used in Type A and Type B Experiments.

Type A.

(1) No manure.
(2) Superphosphate (44/46 per cent. tricalcic phosphate), 3 cwt. per acre.
(3) Superphosphate (44/46 per cent. tricalcic phosphate), 5 cwt. per acre.
(4) Superphosphate (44/46 per cent. tricalcic phosphate), 7 cwt. per acre.

Type B.

(1) No manure.
(2) Superphosphate (44/46 per cent.), 3 cwt. per acre.
(3) Super 3 cwt., plus sulphate of ammonia 1 cwt., per acre.
(4) Super 3 cwt., plus sulphate of ammonia 1 cwt., plus sulphate of potash 1 cwt., per acre.
(5) Super 3 cwt., plus sulphate of potash 1 cwt., per acre.

Analysis of Effects of Different Fertilizers.

The effects of the various fertilizers on yields are shown in Tables 1 to 5 as follows: Table 1—effect of 3 cwt. of superphosphate per acre; Table 2—effect of increasing super above 3 cwt. per acre; Table 3—effect of sulphate of ammonia; Table 4—effect of sulphate of potash.

Comments on Table 1 (next page).

Super 3 cwt.—Average increases due to super at 3 cwt. per acre (forty-four experiments): Table potatoes, 0·96 tons (19 cwt. approximately); seed potatoes, 0·25 tons (5 cwt.): total, 1·32 tons (1 ton 6½ cwt. approximately).

In some cases the increase in total yield is statistically significant, whereas an increase in the yield of table potatoes may not be significant, or *vice versa*. Taking the common-sense viewpoint that such differences are real ones, we have thirty-nine experiments out of forty-four in which super at 3 cwt. per acre has given dependable increases in yield. In four of the other five experiments where increases were not significant the same experiment was conducted in another season.

Table 1.—Showing Effect of 3 cwt. of Superphosphate.

Differences in tons per acre between super 3 cwt. and no manure in experiments during seasons 1925–26 to 1930–31. (Type A and B experiments.)

Unless preceded by a minus sign, the figures signify increases. Increases printed in heavy type are statistically significant. This applies in both cases to all tables in this article.

Experiment No. (see Appendix).	Table.	Seed.	Total.
1925–26 and 1926–27 Seasons.			
1	**2·5**	**0·3**	**2·8**
2	0·0	**0·4**	**0·5**
5	**1·8**	0·1	**1·5**
6	**1·5**	0·3	**1·8**
7	**1·1**	−0·1	**1·3**
8	**0·8**	**0·3**	**1·2**
11	**1·8**	..	**1·8**
1927–28 Season.			
12	**1·0**	**0·6**	**1·8**
13	**0·2**	**0·4**	**0·7**
14	−0·3	−0·2	−0·6
15	**1·2**	0·0	**1·2**
1928–29 Season.			
16	**1·2**	0·0	**1·2**
17	**0·9**	**0·3**	**1·4**
18	**0·6**	**1·3**	**2·1**
19	**0·8**	**0·2**	**1·1**
20	**1·0**	−0·1	**0·9**
21	−0·1	0·2	0·1
35	−0·1	0·0	−0·1
37	0·0	−0·1	0·1
1929–30 Season.			
22	**0·8**	**0·5**	**1·4**
23	**0·9**	**0·5**	**1·8**
24	**0·7**	**0·3**	**1·2**
1929–30 Season—continued.			
25	**0·3**	0·0	0·3
26	**1·1**	**0·4**	**1·8**
27	**1·9**	**0·4**	**3·0**
38	**1·8**	0·2	**2·2**
39	**1·1**	0·1	**1·3**
40	**0·7**	**0·2**	**0·9**
41	**1·9**	**1·2**	**3·8**
42	**1·5**	**0·7**	**2·4**
43	**0·5**	**0·3**	**1·1**
44	**1·8**	−0·5	**1·3**
45	**0·9**	**0·5**	**1·6**
47	**0·5**	**0·3**	**1·8**
48	**0·4**	**0·4**	**1·0**
49	0·2	0·0	0·2
1930–31 Season.			
50	0·3	**0·3**	**0·6**
51	**1·3**	**0·3**	**1·6**
52	−0·1	**0·3**	**0·6**
53	0·4	0·3	**0·7**
54	**1·9**	**0·5**	**2·4**
55	**1·3**	−0·3	0·0
56	**2·5**	0·0	**2·8**
64	**2·5**	0·1	**2·6**
Average of 44 trials	**0·96**	**0·25**	**1·32**

NOTE.—In this and the following table small potatoes are not shown, but are included in the totals; hence the total is not necessarily the sum of table and seed potatoes.

With one exception (Experiments 21 and 25, Voss, Willowbridge), one of the seasons gave a sufficient increase to more than pay for the manure used in both seasons.

Although comparatively poor results were obtained at Voss's Willowbridge, excellent returns resulted from the use of super at Smith's, Willowbridge (Nos. 11 and 15). At Carr's, Methven (No. 35), the trial which suffered very adverse conditions was not repeated. From the writer's knowledge of this district it can be confidently stated that the use of super with the potato crop will pay well.

It can be concluded, therefore, that at least forty-one out of the forty-four areas on which experiments were conducted showed a paying return from the use of super at 3 cwt. per acre.

At £3 per ton for table and £1 10s. for seed potatoes, and 5s. per cwt. for super, the general average monetary return is as follows:—

	£	s.	d.
Value of 19 cwt. table potatoes	2	17	0
Value of 5 cwt. seed potatoes	0	7	6
	3	4	6
Less cost of 3 cwt. of super	0	15	0
Profit per acre	2	9	6

The profit per acre of £2 9s. 6d. represents a 330-per-cent. return on the outlay for superphosphate. It is obvious that farmers cannot afford to neglect the use of super with the potato crop.

The average yields of forty-four experiments in which super 3 cwt. per acre was used were as follow, the figures representing tons per acre :—

	Table.	Seed.	Total.
No manure	4·45	1·95	7·35
Super 3 cwt.	5·41	2·20	8·67

The yields of the no-manure plots ranged from 1 ton to 13·2 tons of table potatoes. The lower-yielding crops were affected either by climatic conditions or disease.

Table 2.—Showing Effect of Increasing Super above 3 cwt. per Acre.

Differences between (*a*) super 5 cwt. and super 3 cwt., and (*b*) super 7 cwt. and super 5 cwt. in experiments during seasons 1925–26 to 1930–31. (Type A experiments.)

Experiment No. as in Appendix.	Increase of Super 5 cwt. over Super 3 cwt. in Tons per Acre.			Experiment No. as in Appendix.	Increase of Super 7 cwt. over Super 5 cwt. in Tons per Acre.		
	Table.	Seed.	Total.		Table.	Seed.	Total.
			1925–26 and 1926–27 Seasons.				
1 ..	**0·8**	0·0	**0·5**	1 ..	−0·1	0·1	0·1
2 ..	**0·5**	−0·1	**0·3**	2 ..	0·1	0·2	**0·3**
7 ..	0·4	**0·3**	**0·6**	7 ..	0·3	0·2	**1·0**
8 ..	0·0	**0·1**	0·2	8 ..	0·2	0·0	0·1
			1927–28 Season.				
12 ..	**0·3**	**0·9**	**1·4**	12 ..	**0·8**	0·0	**0·7**
13 ..	0·0	0·1	0·1	13 ..	0·2	−0·1	0·1
14 ..	**1·2**	0·1	**1·6**	14 ..	−0·9	0·1	−1·0
15 ..	−0·6	0·1	−0·4	15 ..	**1·2**	0·1	**1·3**
			1928–29 Season.				
17 ..	0·1	0·1	0·2	17 ..	0·0	0·2	0·2
18 ..	0·0	0·0	0·0	..	..	..	..
19 .	0·1	−0·1	0·0	19 ..	0·1	0·1	0·2
20 ..	**0·7**	0·1	**1·1**	20 ..	−0·3	0·0	−0·5
21 ..	−0·2	0·0	0·0	21 ..	0·9	0·0	0·9
			1929–30 Season.				
22 ..	**0·8**	**0·2**	**0·9**	22 ..	−0·5	0·0	−0·5
23 ..	**0·6**	0·1	**0·8**	23 ..	0·2	0·2	0·5
24 ..	0·0	0·0	0·1	24 ..	0·1	**0·2**	**0·2**
25 ..	−0·1	−0·1	−0·2	25 ..	−0·1	0·0	−0·1
26 ..	0·1	0·1	0·4	26 ..	0·3	0·0	0·2
27 ..	−0·2	0·0	−0·1	27 ..	**0·5**	−0·1	**0·7**
Average of 19 trials	**0·24**	**0·1**	**0·39**	Average of 18 trials	**0·17**	**0·07**	**0·24**

COMMENTS ON TABLE 2.

Super 5 cwt. per Acre versus Super 3 cwt.—The general average increase of super 5 cwt. over super 3 cwt. is just under ¼ ton of table potatoes, which is sufficient to leave a profit of about 5s. per acre from the extra 2 cwt. of super reckoned on table potatoes alone. It is inadvisable to consider the effect of 5 cwt. of super on the general average, however. The increases fall into two fairly well-defined groups—namely (*a*) those experiments in which there is a significant and quite large increase (Nos. 1, 7, 12, 14, 20, 22, 23), and (*b*) those

in which the increase, if any, is very small and not paying (Nos. 2, 8, 13, 15, 17, 18, 19, 21, 24, 25, 26, 27). Experiment 2 is included in group (*b*) because Experiments 8 and 13 on the same farm in different seasons fall in group (*b*) and indicate that the heavier quantity of super is not profitable in the main on this farm.

The seven experiments in group (*a*) are all on rich alluvial soil, which is potentially and reputedly high-producing land. Although all of the experiments in this group did not give heavy yields, the poor crops can be attributed generally to unusually adverse weather conditions or to seed badly infected with virus diseases.

The average increases over no manure from 3 cwt. of super in experiments in group (*a*) are: Table 1 ton, seed 0·21 ton, per acre. These figures are in very close agreement with the general average increase for forty-four experiments shown in Table 5.

The average increases of 5 cwt. over 3 cwt. of super for group (*a*) are: Table 0·7 tons, seed 0·24 tons, per acre. This gives the following increases over no manure as a result of using 5 cwt. of super: Table 1·7 tons, seed 0·45 tons, per acre.

The result on the financial return shows a net profit from the use of 5 cwt. of super in the seven experiments in group (*a*) of about £4 10s. per acre.

The eleven experiments in group (*b*) show a considerable loss as a result of increasing the amount of super from 3 cwt. to 5 cwt. per acre. Most of these experiments were on light to medium class potato land, although three to four of them were on the richer soils represented by group (*a*).

The conclusion which must be drawn is that the use of super up to the rate of 5 cwt. per acre is, generally speaking, highly paying on the better-class potato soils, but the use of more than 3 cwt. per acre is not justified on the lighter to medium class soils.

Super 7 cwt. versus Super 5 cwt. per Acre.—Increasing the quantity of superphosphate to 7 cwt. per acre has caused a general average increase (eighteen trials), which just about meets the cost of the extra super. The individual results are very inconsistent, however. In two experiments the yields have been significantly depressed below those from 5 cwt. of super. In three experiments the increases of table potatoes are large and significant, but in two of these an undue superiority is given to the effect of super 7 cwt. compared with super 5 cwt., as the actual effect of super 5 cwt. was less than that from super 3 cwt. The results indicate that *in the main* there is no justification for using more than 5 cwt. per acre of super even on the best potato soils.

COMMENTS ON TABLE 3.

Super 3 cwt., plus Sulphate of Ammonia 1 cwt. versus Super 3 cwt.—The addition of 1 cwt. of sulphate of ammonia to super at 3 cwt. has been tried in thirty-six experiments. The average increases—0·48 tons of table (9½ cwt. approximately) and 0·25 tons (5 cwt. approximately) of seed potatoes—are worth, on the values adopted, about £1 17s. This increase has been obtained from an outlay of 12s. on 1 cwt. of sulphate of ammonia, leaving a net profit of £1 5s. per acre, or approximately 200 per cent., on the outlay.

Table 3.—Showing Effect of Sulphate of Ammonia.

Differences between (*a*) super 3 cwt., plus sulphate of ammonia 1 cwt., and super 3 cwt.; (*b*) super 3 cwt., plus sulphate of ammonia 1 cwt., plus sulphate of potash 1 cwt., and super 3 cwt, plus sulphate of potash 1 cwt.

Experiment No. as in Appendix.	Increase of Super 3 cwt., plus Sulphate of Ammonia 1 cwt., over Super 3 cwt., in Tons per Acre.			Experiment No. as in Appendix.	Increase of Super 3 cwt., plus Sulphate of Ammonia 1 cwt., plus Sulphate of Potash 1 cwt., over Super 3 cwt., plus Potash, in Tons per Acre.		
	Table.	Seed.	Total.		Table.	Seed.	Total.
			1925–26 and 1926–27 Seasons.				
3	1 8	0·3	2·1	3 ..	1 3	0·2	1·4
4 ..	0·3	0 5	0·9	..	..	..	..
6 ..	−0 1	0·4	0·5	..	..	..	..
9 ..	−0·7	0·4	−0·3	9 ..	−0·4	0·3	0·4
10	0·0	0·1	0·2	..	..	..	..
			1927–28 Season.				
28 ..	−0·9	0·4	−0·3	28 ..	−0·6	0·1	−0·4
29 ..	0·4	0·4	0·8	29 ..	0 4	0·5	1·0
30 ..	0·6	0·1	0·9	30 ..	−0·2	−0·2	−0·2
31 .	1·2	0·0	1·1	31 ..	0·1	−0·1	0·0
			1928–29 Season.				
32 .	0·8	0·5	1·4	32 ..	1·5	0·1	1·6
33 ..	0·4	1·2	1·8	33 ..	0 9	1·4	2·5
34 .	0·7	0·1	0 8	34 ..	0·3	0·1	0·5
35 ..	0·2	0·2	0·5	..	..	.	..
36 .	0·8	0·2	1·1	36 ..	0·4	−0·1	0·4
37 ..	0·1	0·1	0 5	37 ..	−0·2	0·2	0·6
57 .	1·0	0·0	1·1	57 ..	0·7	0·1	0·8
58 ..	0·3	0·3	0·4	58 ..	0 3	0·0	0·6
			1929–30 Season.				
38 ..	1·2	0·0	1·2	38 ..	0·7	0·1	1·0
39 ..	1·0	0·5	1·6	39 ..	0·6	0·5	1·3
40 ..	0·1	0·2	0·4	40 ..	0·7	0·3	1·1
41 ..	1·0	−0·3	0·4	41 ..	0·7	−0·3	0·3
42 ..	0·6	0·4	1·0	42 ..	1·2	0·1	1·2
43 ..	1·2	0 5	2·1	43 ..	1·5	0·3	2·1
44 ..	0·1	0 6	0·8	44 ..	0·6	0·4	1·2
45 ..	1·0	−0·1	1·4	45 ..	0·9	0 3	1·5
46 ..	0·7	0·3	1·2	46 ..	0·3	0·3	0·8
47 ..	0·2	0·1	0·6	47 ..	0·4	0·2	1·0
48 ..	0·2	0·1	0·4	48 ..	−0·1	−0·3	−0·5
49 .	0·5	0·1	1·0	49 .	0·0	0·0	−0·2
..	..	..	.	59* ..	0·1	0·1	0·2
..	..	..	..	60* ..	0·6	0·6	1·5
..	..	..	..	61* ..	−0·3	0 2	−0·1
..	..	..	..	62* ..	0·2	0·1	0·4
..	..	..	..	63* ..	1·1	0·1	1·5
			1930–31 Season.				
50 ..	0·2	0·2	0·4	50 ..	0·5	0·2	0·7
51 ..	0·3	−0·1	0·2	51 ..	0·1	−0·1	0·0
52 ..	−0·2	0·3	0·7	52 ..	0·0	0·3	1·1
53 ..	0·4	0·3	0 9	53 ..	0·4	0·3	0 9
54 ..	1·3	0·5	1·8	54 ..	0·8	0·2	1·0
55 ..	0·3	0·2	0·6	55 ..	1·0	0·4	1·7
56 ..	0·2	0·1	0·8	56 ..	0·6	0·1	1·1
..	..	..	..	64* ..	0·9	0·0	0·9
Average of 36 trials	0·48	0·25	0·87	Average of 38 trials	0·47	0·18	0·81

* 132 lb. sulphate of ammonia used.

Only eighteen experiments show statistically significant increases in the yields of table potatoes. In eleven other experiments significant increases in total yields are shown, though not significant in the case of table tubers. It is reasonable to assume, therefore, that at least twenty-nine of the thirty-six trials show significant increases due to

the use of nitrogen. In two cases (Experiments 39 and 52) yields of table potatoes are significantly reduced, although the yields of " seed " are increased.

Super 3 cwt., plus Sulphate of Potash 1 cwt., plus Sulphate of Ammonia 1 cwt. versus Super 3 cwt., plus Sulphate of Potash 1 cwt.—The general average result of using sulphate of ammonia as an addition to super plus sulphate of potash in thirty-eight trials is very similar to that just commented on. In some cases, notably in Experiments 33, 40, 42, 44, and 55, the effect of using sulphate of ammonia in addition to super plus potash is much better than where sulphate of ammonia is added to super only. In Experiments 3, 31, 36, 49, and 54 the reverse is very much in evidence.

In experiments 30, 31, 48, and 49 super plus sulphate of ammonia and super plus potash have both been superior to super alone, but the complete fertilizer—super plus potash plus sulphate of ammonia—is no better than super plus sulphate of ammonia or super plus potash. Possibly available moisture has limited the effect of the complete fertilizer.

Response to Sulphate of Ammonia as affected by Soil and Climatic Conditions.—Consideration of the response to sulphate of ammonia in relation to soil and climatic conditions leads to the conclusion that the effectiveness of sulphate of ammonia is governed more by climatic conditions than by soil conditions. Good and poor responses have occurred with more or less equal frequency on all classes of soil. Climatic conditions do, however, appear to have a marked influence on the crop response, especially in regard to table potatoes.

The use of sulphate of ammonia undoubtedly causes the formation of increased numbers of tubers. So long as the moisture supply is reasonable and well distributed over the growing season a normal percentage of tubers will grow to the table size, but if dry conditions are experienced, particularly during December and January, a smaller percentage of the tubers than usual attain the table size. This effect is so marked in a few cases as to cause an actual reduction in the yield of tables, though the yields of seed and small may be so increased as to cause a greater total yield from plots sown with sulphate of ammonia than where no sulphate of ammonia is used.

Since it is impossible to predict climatic conditions sufficiently far ahead, the obvious thing to do is to use sulphate of ammonia consistently, as the results here presented indicate that over the average of a number of seasons the returns will be paying.

COMMENTS ON TABLE 4.

Super 3 cwt., plus Sulphate of Potash 1 cwt. versus Super 3 cwt.—In spite of its reputation as a desirable fertilizer for the potato crop, potash has not been particularly effective in general. As its effectiveness appears to be governed principally by soil-type, it is not proposed to discuss the results from point of view of the general average.

The inconsistency of the effect of potash makes interpretation of results rather difficult. In Experiments 37, 42, 47, 54, and 58 it has proved effective and very profitable when used with super on the one hand, and with super plus sulphate of ammonia on the other. In Experiments 30, 31, 48, and 49 good and paying returns have resulted

when potash has been used with super, but when used with super plus sulphate of ammonia the yields have been practically no better than those from super plus potash or super plus sulphate of ammonia. In Experiments 33, 52, and 55 potash used with super gave poor to fair results, but gave better results when used with super plus sulphate of ammonia as a complete manure. In two experiments, 40 and 44, the use of potash caused the yields to be depressed.

Table 4.—Showing Effect of Potash.

Differences in tons per acre between (*a*) super 3 cwt., plus sulphate of potash 1 cwt., and super 3 cwt.; (*b*) super 3 cwt., plus sulphate of ammonia 1 cwt., plus sulphate of potash 1 cwt., and super 3 cwt., plus sulphate of ammonia.

Unless preceded by a minus sign, the figures signify increases. Increases printed in heavy type are statistically significant.

Experiment No. as in Appendix.	Increase of Super 3 cwt., plus Sulphate of Potash 1 cwt., over Super 3 cwt.			Experiment No. as in Appendix.	Increase of Super 3 cwt., plus Sulphate of Ammonia 1 cwt., plus Sulphate of Potash 1 cwt., over Super 3 cwt., plus Sulphate of Ammonia 1 cwt		
	Table.	Seed.	Total.		Table.	Seed.	Total.
			1925–26 and 1926–27 Seasons.				
3 ..	0·4	0·1	0·5	3 ..	−0·2	−0·1	−0·2
..	..	..	..	4 ..	0·2	0·0	0·2
..	..	..	..	6 ..	0·0	−0·2	−0·2
9 ..	−0·2	−0·1	−0·2	9 ..	0·0	0·2	0·5
..	..	..	..	10 ..	0·1	0·0	0·1
			1927–28 Season.				
28 ..	−0·2	0·0	−0·2	28 ..	0·1	−0·3	−0·3
29 ..	0·1	0·0	0·0	29 ..	0·1	0·1	0·2
30 ..	**0·9**	0·2	**1·1**	30 ..	0·1	−0·1	0·0
31 ..	0·6	0·3	**0·9**	31 ..	−0·5	0·2	−0·2
			1928–29 Season.				
32 ..	−0·4	**0·2**	−0·2	32 ..	0·3	−0·2	0·0
33 ..	0·2	−0·2	−0·1	33 ..	**0·7**	0·0	**0·6**
34 ..	0·4	0·1	0·3	34 ..	0·0	0·1	0·0
..	..	..	..	35 ..	0·1	0·1	0·2
36 ..	−0·1	0·0	−0·1	36 ..	−0·5	−0·3	−0·8
37 ..	**1·8**	**1·1**	**3·0**	37 ..	**1·5**	**1·2**	**3·1**
57 ..	0·2	−0·1	0·2	57 ..	−0·1	0·0	−0·1
58 ..	**0·5**	0·2	**0·4**	58 ..	**0·5**	−0·1	**0·6**
			1929–30 Season.				
38 ..	0·7	−0·1	0·6	38 ..	0·2	0·0	0·4
39 ..	0·4	0·1	0·4	39 ..	0·0	0·1	0·1
40 ..	−0·4	−0·1	−0·5	40 ..	0·2	0·0	**0·2**
41 ..	**0·7**	−0·1	0·3	41 ..	0·4	−0·1	0·2
42 ..	**0·7**	0·1	**0·8**	42 ..	**1·3**	−0·2	**1·0**
43 ..	0·1	0·2	**0·4**	43 ..	**0·4**	0·0	**0·4**
44 ..	−0·9	0·2	−0·8	44 ..	−0·4	0·0	−0·4
45 ..	0·1	0·1	0·4	45 ..	0·0	0·5	0·5
46 ..	0·1	0·1	0·3	46 ..	−0·3	0·1	−0·1
47 ..	0·5	**0·4**	**1·1**	47 ..	**0·7**	**0·5**	**1·5**
48 ..	0·3	0·3	**0·8**	48 ..	0·0	0·1	**0·1**
49** ..	**0·6**	0·0	**0·9**	49 ..	**0·2**	−0·1	−0·3
			1930–31 Season.				
50 ..	−0·1	0·0	−0·1	50 ..	0·2	0·0	0·2
51 ..	**0·4**	−0·2	0·2	51 ..	0·2	−0·2	0·0
52 ..	**0·8**	0·0	0·1	52 ..	**0·5**	0·0	**0·5**
53 ..	**0·1**	−0·1	−0·1	53 ..	0·1	−0·1	−0·1
54 ..	**1·1**	**0·8**	**1·4**	54 ..	**0·6**	0·0	**0·6**
55 ..	−0·2	−0·1	−0·2	55 ..	**0·5**	0·1	**0·9**
56 ..	0·1	0·0	−0·0	56 ..	0·5	0·0	0·3
Average of 32 trials	**0·27**	**0·08**	**0·36**	Average of 36 trials	**0·21**	**0·04**	**0·27**

Districts represented by the following experiments are indicated as being responsive to potash with the potato crop to a paying extent :—

Experiments 33 and 42 : Westaway, Kirwee, Canterbury.
,, 43 and 52 : Crozier, Mitcham, Mid-Canterbury.
,, 30 and 58. Westaway, Temuka, South Canterbury.
,, 31* : Smith, Willowbridge, South Canterbury.
,, 54 : Gibson, Taieri, South Otago.
,, 49 and 55 : Knibbs, McNab, Southland.
,, 37 and 47. Experimental Farm, Gore, Southland.
,, 48. Friend, Gore, Southland.

* It should be noted that potash was quite ineffective when used with super and sulphate of ammonia in this experiment, and that it was also ineffective in Experiments 36 and 46 at Voss's, Willowbridge. In other of the above experiments good results have been obtained when potash was used in conjunction with super, but very indifferent results occurred when potash was added to super and sulphate of ammonia and *vice versa*. The failure of the complete manure to give better results than super plus sulphate of ammonia or super plus potash cannot be attributed to either the potash or the sulphate of ammonia. As stated previously, it is possible that available moisture has limited the effect of the complete manure.

Type C Experiments.

The following treatments were used in the Type C experiments :—

(*a*) (1) Superphosphate 44/46, 3 cwt. per acre
(2) Super 3 cwt, plus sulphate of ammonia 1 cwt., per acre.
(3) Ammophos, 169 lb. per acre
(4) Super 3 cwt., plus sulphate of potash, 1 cwt, per acre.
(5) Super 3 cwt., plus sulphate of potash 1 cwt., plus sulphate of ammonia 1 cwt, per acre.

(*b*) (1) Super 3 cwt, plus sulphate of potash 1 cwt., per acre.
(2) Super 3 cwt., plus sulphate of ammonia 132 lb., plus sulphate of potash 1 cwt., per acre.
(3) *Ammophos 200 lb., plus sulphate of potash 1 cwt., per acre.
(4) Diammonphos 132 lb. plus sulphate of potash 1 cwt., per acre.

* Note.—Where the ammonium phosphate (Ammophos and Diammonphos) were used the quantities were adjusted so as to supply the same amounts of nitrogen and phosphate as were supplied by the super plus sulphate of ammonia mixture. The Ammophos was a mixture of two grades, one containing 10·7 per cent. of nitrogen and 48 per cent of phosphoric anhydride, and the other containing 16·5 per cent. of nitrogen and 20 per cent. of phosphoric anhydride. Diammonphos contains 20·5 per cent. of nitrogen and 52·5 per cent. of phosphoric anhydride.

COMMENTS ON TABLE 5.

In two of the trials (Nos. 57 and 63) in Table 5, a mixture of super plus sulphate of ammonia has proved significantly better than Ammophos—in Experiment 57 by 0·7 tons table potatoes, and in Experiment 63 by 0·3 tons table and 0·3 tons seed potatoes.

In Experiments 62, 63, and 64 the mixture containing super plus sulphate of ammonia has proved significantly superior to that containing Diammonphos—in No. 62 by 0·9 tons, and in No. 64 by 0·3 tons of table potatoes. In No. 63 the difference in table potatoes is not significant, although the seed and total yields differ significantly.

Since neither Ammophos nor Diammonphos have proved superior to super plus sulphate of ammonia to a significant extent in any of the trials, but super plus sulphate of ammonia has in four out of eight

Table 5.—Comparison of Super 3 cwt., plus Sulphate of Ammonia 132 lb. (or 1 cwt.), with same Amount of Phosphate and Nitrogen in Form of (a) Ammophos and (b) Diammonphos.

Experiment No. as in Appendix.	Increases in Tons per Acre of Super plus Sulphate of Ammonia over Ammophos			Experiment No as in Appendix.	Increases in Tons per Acre of Super plus Sulphate of Ammonia over Diammonphos.		
	Table.	Seed.	Total.		Table.	Seed.	Total.
				1928–29 Season.			
57 ..	0·7	0 0	0 7	..	..	..	..
58 ..	0 4	0·2	0·2	..	..	..	..
				1929–30 Season.			
59* ..	0·0	0·0	0 0	59 ..	−0·1	0 0	0 0
60 ..	..	..	.	60 .	0·0	0·2	0·2
61* ..	−0·6	−0·4	−1·0	61 ..	—0·1	0·0	—0·1
62* ..	0·1	0·1	0·2	62 ..	0·9	0·2	1·3
63* ..	0·3	0·3	0·7	63 ..	0·4	0·2	0·7
				1930–31 Season.			
64* ..	0·2	0·0	0·2	64 ..	0·3	−0·1	0·2
Average of 7 trials	0·16	0·03	0 14	Average of 6 trials	0·23	0 08	0 38

* Sulphate of potash at 1 cwt. per acre supplied to each of the three treatments mentioned.

trials proved superior to either Ammophos or Diammonphos, the logical conclusion is that the mixture of super plus sulphate of ammonia is in the main superior in effect to ammonium phosphates as represented by Ammophos and Diammonphos.

The effects of sulphate of ammonia and potash in these trials come under consideration with other trials in Tables 3 and 4.

TYPE D EXPERIMENTS.

Treatments used in Type D experiments were as follow:—

(1) Super 3 cwt., plus sulphate of ammonia 1 cwt., plus sulphate of potash 1 cwt., per acre.
(2) Super 3 cwt., plus sulphate of ammonia 1 cwt., plus sulphate of potash 1 cwt., plus ground sulphur 3 cwt., per acre.

Table 6.—Comparison of Super 3 cwt., plus Sulphate of Ammonia 1 cwt., plus Sulphate of Potash 1 cwt., with same plus Ground Sulphur 3 cwt. (Type D Experiments.)

Experiment No. as in Text.	Season.	Increases in Tons per Acre of Mixture containing Sulphur over No Sulphur.		
		Table.	Seed.	Total.
65	1929–30	0·2	0·0	0·2
66	1929–30	0·8	0·7	1·5
67	1930–31	0·2	−0·1	0·1
Average of 3 trials ..	..	0·4	0·2	0·6

COMMENTS ON TABLE 6.

The use of sulphur has caused the yield to be increased to a significant extent in one experiment, No. 66. The value of the increase is about £3, and the cost of 3 cwt. of sulphur at the present price somewhat more than £3.

ACKNOWLEDGMENTS.

The assistance of those farmers who provided land and facilities for carrying out the foregoing experiments is gratefully acknowledged.

The following Fields Division officers were concerned with the carrying-out of the trial: Messrs. Elliott (Marlborough), A. Y. Montgomery and W. C. Stafford (Christchurch), E. M. Bates (Ashburton), R. A. Calder and K. M. Montgomery (Timaru), A. Hume (Dunedin), G. Wild and A. S. Duff (Invercargill), A. Stuart (Gore) and J. Sleeman, Gore Experimental Area.

APPENDIX.

Statement of Names and Locations of Co-operating Farmers and Numbers used to indicate Experiments in Tables 1, 2, 3, 4, and 5.

Name and Location.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.
L. C. Banks, Coutts Island, Canterbury	1, 3	7, 9	..	..	..	..
W and A. Campion, Prebbleton, Canterbury	2, 4	8, 10	13, 29	..	..	..
S. McIntosh, Kaiapoi, Canterbury ..	.	5	12, 28	.	.	..
H. McLenaghen, Killinchy, Canterbury	..	6	.	..	..	..
W. Smith, Willowbridge, Canterbury ..	.	11	15, 31	..	..	..
W. Westaway, Temuka, Canterbury .		..	14, 30	20, 58	..	..
J. McMullen, Kaiapoi, Canterbury ..	..	.	.	16, 57	23, 59	..
A. K. Case, Prebbleton, Canterbury ..	..		..	17, 32	39	..
F. Westaway, Kirwee, Canterbury .	..	..	..	18, 33	42	..
J. C. Lockhead, Rokeby, Canterbury .	..	..	.	19, 34	..	..
H. Voss, Willowbridge, Canterbury ..	..	.	..	21, 36	25, 46	..
J. Carr, Methven, Canterbury .	..	..	..	35	..	..
Experimental Area, Gore, Southland ..	..	.	..	37	47	..
W. Blick, Springlands, Marlborough	..	..	..	..	22	.
W. J. Crozier, Mitcham, Canterbury ..	..	..	..	..	24, 43	52
Experimental Farm, Winton, Southland	..	..	..	..	26, 63	..
R. Knibbs, McNab, Southland ..	..	..	..	..	27, 62	..
M. S. Goodwin, Rangiora, Canterbury	..	..	..	..	38	..
W. McLauchlan, Leeston, Canterbury..	..	..	..	..	40, 65	..
D. Marshall, Leeston, Canterbury ..	..	..	..	..	41	..
A. Breakwell, Wakanui, Canterbury ..	..	..	..	..	44, 60	..
A. Spillane, Winchester, Canterbury ..	..	..	..	..	45	53
G. Friend, Gore, Southland	..	..	..	..	48	..
R. Knibbs, McNab, Southland ..	..	..	..	..	49	55
C. R. Sheat, Moneymore, Otago ..	..	..	..	..	55, 66	..
K. Rodger, Tapanui, Otago .. .	..	..	..	..	61	..
High School, Rangiora, Canterbury ..	..	..	..	..	..	50
C. Redmond, Kimberley, Canterbury ..	..	..	..	..	..	51, 67
A. Gibson, North Taieri, Otago ..	..	..	..	..	..	54
L. King, Raukahauka, Southland ..	..	..	..	..	..	56
F. W. Carpenter, Prebbleton, Canterbury	..	..	..	..	..	64

—A. W. Hudson, Crop Experimentalist.

—J. W. Woodcock, Assistant Crop Experimentalist.

Inspection of Milking-machines.—This subject is referred to as follows in the annual report of the Dairy Division for 1930–31: "In districts where Farm-dairy Instructors are operating these officers gave special attention to the inspection of new and renovated milking-plants installed, and elsewhere the inspection was carried out as opportunity offered by the Butter and Cheese Instructors. During the year some 3,125 plants were inspected, the great majority of which were found to comply with the regulations. A few required minor adjustments, and necessitated a further visit before being finally passed. The reduction in the number of Farm-dairy Instructors must necessarily throw more work on the Dairy Instructors in connection with the inspection of the erection of new milking-machines, and any re-erections of used machines. This is important work, and has been the means of ensuring that these installations are such that they can be kept clean without unnecessary care and attention. Since the amending regulation has placed some responsibility on the vending and erecting firm, fewer erections are found to contravene the regulations."

IMPORTATION OF SELECT GRAPE-VINES.

THE grape-vine varieties detailed in the following lists were imported by the Department of Agriculture during the past year and planted in the experimental vineyard at Te Kauwhata Horticultural Station to test their suitability for New Zealand conditions.

Under the heading of "Ripening Period," the letter "P" indicates precocious varieties ripening before the Golden Chasselas, which latter ripens at the end of February or beginning of March; the figure "1" means ripening at approximately the same time as the Chasselas; "2" in the middle of March; "3" towards the end of March and in the beginning of April. The exact period of ripening varies with seasonal climatic conditions, varying aspects, &c.

Variety.	Colour.	Ripening Period.	Remarks
Central European Varieties from Vienna.			
Green Sylvaner	Green ..	1–2	Wine. Heavy bearer. Produces a light agreeably flavoured wine. Extensively grown in Austria and Czecho-Slovakia.
Frohlich-Sylvaner ..	Green ..	1–2	Wine. A selected Green Sylvaner.
Riesling × Sylvaner (Muller-Thurgau)	Green ..	1–2	Wine. A new variety, combining quality with quantity. Being planted extensively in Central Europe and Switzerland.
Green Veltliner	Green ..	P, 1	Wine. Abundant production of wine having a fine bouquet.
Red Veltliner	Red ..	P, 1	Ditto.
Brown Veltliner	Brown ..	P, 1	Ditto
Neuburger	White ..	P, 1	Wine. A new variety, producing excellent wine. Good bearer.
Zierfandler	Red ..	1–2	Wine Except for colour, the wine is identical with that of the Green Sylvaner.
Rotgipler	White ..	2	Wine. Very heavy bearer, of good-quality wine. Suitable for north-east slopes in the warmer parts of New Zealand.
Erzerzo (Best of All) ..	White ..	1–2	Table and wine. Abundant production of good wine. Juice very sweet.
Mezes (Honey Grape) ..	White ..	P	Table and wine. Heavy cropper. Wine ordinary. Good table fruit. Exceptionally sweet.
Muscat Ottonel	White ..	1–2	Table and wine. Muscat flavour.
Perle de Csaba	White ..	P	Table. An exceptionally early and excellent Muscat-flavoured grape.
Ezereves	White ..	P, 1	Table. Remarkably large bunches and berries, resembling a white Gros Colman. Excellent flavour.
Vines received in Exchange from the South Australian Department of Agriculture.			
Red Hanepoot	Red ..	2–3	Table. A red Muscat of Alexandria. A South African production.
Brown Muscat	Brownish-red	1–2	Table and wine. A better bearer than the Muscat de Frontignan. Stronger in flavour, but not so delicate. Possibly identical with the Muscat Rouge de Madère imported in 1929 from France.
Quick's Early	White ..	1	Wine. A good variety from South Australia.
Black Monukka	Black ..	2	Table. Large bunches of medium-sized berries. Pleasant flavour. Almost seedless.
Gros Lot	Black ..	1–2	Wine. Heavy cropper. Produces a good "vin ordinaire" in the Tourraine District of France.
Bellino Nero	Black ..	2	Table. Large handsome bunches and berries. Excellent flavour.
Melon	White ..	1	Wine. Suitable for clay soils, on which it produces abundance of a Chablis type of wine. Spur pruning recommended.
Malegue 51–20	White ..	2	Table. A direct producer. Good bearer of large bunches and berries. Muscat flavour.
Riparia × Cordifolia-Rupestris 106–8	..	..	Resistant stock. Very vigorous. Recommended for compact, dry, and poor soils containing little lime. Affinity good with most varieties.

Previous lists of recently imported varieties were given in the February, 1928, and October, 1929, issues of this *Journal*.

—*J. C. Woodfin, Vine and Wine Instructor, Horticulture Division.*

SEASONAL NOTES.

THE FARM.

Pasture Management.

In general, until comparatively recently, so long as there was plenty of unconsumed growth on pastures in summer, farmers were quite satisfied they were efficiently meeting the needs of the situation, although at times the more thoughtful among them were sorely puzzled in their attempts to provide themselves with a line of reasoning which would satisfactorily explain why the production of stock fell off at a rate unduly rapid, in view of the fact that the stock seemed to be in the midst of plenty. We now know that more attention should have been given to the quality of the feed which is governed to a large extent by the stage of maturity.

Usually in January and February any weakness in the pastures as a source of feed for " wet " stock is more likely to be in respect to quality than to quantity—the feed provided by grassland at this season frequently is undesirably woody, and consequently of the low feeding-value associated with a long and mature condition of growth. This year in certain parts, because of the unfavourable season, there was not the usual amount of surplus feed to bring about the falling-off in the quality of the late summer feed to the usual extent, but, nevertheless, some farmers will be faced with the need of adopting all practices which will give feed of good quality for milk-production.

The primary need is for leafy growth, which is not naturally produced by pastures in late summer. Topping of pastures with the mower in February may be advisable in the interests of feed-quality ; if the growth is rank and flower-heads have developed, mowing will tend to induce fresh leafy growth from the base of the topped plants. Mowing may also be advisable because of the presence of such weeds as spear thistles, docks, fat-hen, and willow-weed or red-shank, which, by their shading influence, tend to appreciably weaken useful constituents of a pasture. Indeed, the detrimental effect of shade-creating weeds, if not checked, may be so great as to lead to the destruction of individual useful plants and their eventual replacement by weed species.

Top-dressing with phosphatic material in the latter part of the summer or in early autumn is also likely as a rule to stimulate leaf-production in an advantageous manner. When the rainfall is adequate the application of phosphates at this season quickly stimulates growth, while if dry conditions follow the distribution of the phosphate its beneficial influence will be delayed, but not lost. Further, phosphates applied at this season may ordinarily be depended upon to stimulate growth appreciably in the following spring, and—a point in favour of the practice—they will not so markedly stimulate growth in the following summer, when it is often a task to control it properly, as they would if applied in July or August.

Both the top-dressing and the topping in the manner specified tend not only to give more leaf growth than would normally occur at this season, but also to level out the feed-supply available from the pastures throughout the year, and this, equally with quality in the feed, should be one of the objectives of modern grass-farming.

Quality and evenness in the supply of feed from pastures are having more attention given to them than in the past. There is solid reason for this : our need for them has grown as our knowledge relative to them has grown. There has been a tendency to depend more and more upon pastures

as a source of feed for stock, and this has been at the expense of crops, such as soft turnips and rape, which are markedly low in woodiness and high in digestibility. It is to be expected that the pastures, if they are to replace such crops successfully, must provide feed with essential characters similar to those provided by these crops. And this is what is proving to be the case in practice—only leafy pasture-growth, low in woodiness and high in digestibility, can efficiently replace standard successful summer supplementary crops. Whether such leafy pasture-growth should be made wholly to replace summer supplementary crops is a management or economic question about which we are not at present directly concerned. That it can, if necessary, efficiently replace such crops is a fact of animal nutrition that has been amply demonstrated, and we know definitely that as a rule pastures in summer should be kept as leafy as possible.

Pasture Establishment.

At times the preparation of ground for autumn sowing of pastures is not commenced early enough to allow of the most economical production of the firm fine seed-bed which is essential for the obtaining of full success from the use of suitable seed and manure. The process of natural weathering can be a considerable aid in the production of such a seed-bed, but it requires time and, partly because of this, farmers generally should proceed with the preparation of seed-beds for pastures as soon as practicable.

The matter of pasture seed mixtures will be considered in some detail in next month's notes. In this connection the recent development of most practical moment is probably the recognition of the paramount importance of using truly perennial strains of rye-grass, and, as supplies of certified seed will be available when sowing-down is being done, there is no real justification for the use of inferior strains of rye-grass when the permanence of the new pasture is desirable.

The results of the more recent work point also to the conclusion that in the past money has been wasted on account of the use in seed mixtures of some species which served no useful purpose. The present tendency is to reduce the number of species and so lower the cost of mixtures. Details may be obtained from officers of the Fields Division in the various districts.

In districts where the grass-grub is in evidence it is not a safe practice to sow down pastures after a cereal crop or a grass crop. On the other hand, land which was free from plant-growth in November and December is very likely to be free from grass-grub infestation, especially if it was not previously infested with the grub.

Critical Summer Feeding Period.

Frequently the January–February period is marked by a fall in dairy production much greater than may reasonably be attributed to natural causes, such as the advancement of the milking season, and observation has shown that this fall is almost invariably linked with poor feeding. If proper measures were not taken earlier not a great deal, apart from the pasture-management measures already considered, can be done at this stage to avoid this most unwelcome fall. However, it is worth remembering that at times certain crops may advisedly be fed for the purpose of obviating an excessive fall, even though these crops if left longer would give greater yields. For example, a partly grown crop of soft turnips fed at this stage when it is badly required may prove of greater value than it would if fed when it is fully grown, but not so badly needed. In addition to turnips, crops of young succulent lucerne, red clover, maize, and millet may suitably be fed now, but if such crops are allowed to become mature and woody they develop the same weaknesses as stemmy grass.

Seasonal Work with Lucerne.

It is at times advisable in February to mow young lucerne which was sown in November or December. This is generally due to a vigorous development of weeds which tend to choke the lucerne seedlings, but if there is no evidence that the lucerne is in danger of being harmed by weeds then there is no need to carry out the first mowing early, for during the young stages of the crop unchecked leafage assists materially in building up an extensive root-system, which is apt to serve well in subsequent critical periods.

Good results may be expected from top-dressing lucerne with phosphates in summer. As a rule, summer top-dressing of lucerne is preferable to spring top-dressing, which under some circumstances may benefit, equally with the lucerne, invading plants which it is desired to suppress.

As a rule, a suitable time for the cultivation of established lucerne is after the second cut of the season; the primary object of cultivation is usually destruction of weeds, and the dry weather which is commonly experienced at about the time of the second cut assists this appreciably.

At times good results are obtained from sowing lucerne in February. Good germination is favoured by the warmth which the soil then possesses. One reason for February sowing is the avoidance of the competition of those annual weeds, such as fat-hen, which germinate in the spring and tend to hinder the strong establishment of spring-sown seedlings. Generally, however, November–December sowing of lucerne is favoured on the basis of results.

Late-sown Turnips and Catch-crops.

In several localities turnips may still be sown with the prospect of quite satisfactory results. Suitable varieties for use at this stage are Imperial and Hardy Green Globe and White Stubble. Swedes are less satisfactory for late sowing, because of the greater possibility of severe attacks by insect pests, and this especially should a dry autumn occur.

On many farms there will be opportunity for useful catch-cropping, which promises to be particularly advisable this year because of unusually low reserves of hay, silage, &c. Land in oat stubble, for instance, if worked as soon as the oat crop is removed and then sown without delay in Western Wolths or Italian rye-grass and red clover is likely to provide considerable green feed, which, as a rule, is very welcome to sheep-farmers working under Canterbury or similar conditions. Black skinless barley also, sown after oats at the rate of 2½ bushels an acre, develops so quickly that it will provide good feed for dairy cows or sheep at a time, about two months later, when it is much required. Algerian oats are useful for providing later feed. With all these crops it is as a rule profitable to apply (at the time of sowing) superphosphate at the rate of 1 cwt. to 3 cwt. an acre, according to the natural fertility of the land.

Importance of Summer Cultivation.

One of the major weaknesses of cropping-work in New Zealand farming is the neglect of surface-cultivation during summer. All crops such as potatoes, mangels, carrots, maize, &c., sown in rows wide enough to allow of intercultivation respond profitably to it, carried out at regular intervals as long as it is possible to work between the rows. It is impossible to say what interval should occur between successive cultivations, for a beating rain immediately after one cultivation may cause the surface of the soil to cake and make it advisable to cultivate again as soon as possible. Cultivations should certainly be frequent enough to maintain the surface layer of soil in a loose condition, and to do this, particularly in dry climates, it may be advisable to cultivate even though weeds are not at all prominent.

The main object, in the absence of weeds, is primarily the conservation of soil-moisture, which is a more weighty factor in the production of crops than many seem to realize.

Summer Weed Control.

The late summer usually offers considerable opportunity for endeavour directed at weed-suppression. In the first place, certain crops such as potatoes, mangels, and carrots are kept reasonably free from weeds right up to midsummer, but after this weeding generally does not receive attention. It certainly does not call for as much attention as it did earlier, but it does call for some, otherwise a late batch of weeds will most likely produce seed. Though this will probably be a really light invasion of weeds insufficient to appreciably lower the yield of crop, it will be heavy enough to produce a host of seeds which will copiously foul the ground for succeeding crops, and herein is the great damage that should be avoided, otherwise so-called cleaning crops such as potatoes and mangels will virtually become fouling crops.

Summer fallow or prolonged summer cultivation, by itself, generally is no longer looked upon as a satisfactory or economical means of suppressing "twitchy" weeds such as couch-grass, yarrow, and Californian thistle. While summer cultivation is of undoubted value in weakening such weeds, and on that account should be practised, particularly in the drier parts, it seldom brings about the complete eradication of these weeds—sufficient live remnants remain to form the basis of future heavy reinfestation of the land. For economical results the summer tillage should be linked with other suitable measures which will continue the weakening of the weed population that was initiated by the cultivation. For instance, if considerable summer cultivation is followed by a dense autumn-sown crop the injurious influence of the cultivation will be continued on account of the shading occasioned by the crop, and, if necessary, a further dense crop may be grown to continue the detrimental shading until the weeds have been destroyed. The essence of economic weed-control of this type is to take care that the shading crops are themselves also profitable ones.

—*R. P. Connell, Fields Division, Palmerston North.*

Fattening Lambs on Rape.

The rape crop is almost entirely one for the sheep-farmer, and provides a useful supply of feed for lambs when the grass begins to go off. Late lambs can be fattened for the freezing-works on rape, its fattening capacity comparing well with other crops used for this purpose. It is usual to combine mustard with the rape to act as a corrective.

It is usual to feed off the crop in breaks, a run-off on grass being provided. When a change of pasturage is used for any class of stock it is advisable to bring about the change gradually, allowing a few hours' grazing at first until the stock becomes accustomed to the new feed. To prevent bloating and occasional deaths it is also preferable to commence using the crop after a spell of dry weather rather than after rain. The lambs should have access to rock salt.

A good crop may be grazed early, closed up for a bit and grazed again, even a third period being obtained in some cases. The mistake is often made of allowing the rape crop to become too mature before turning lambs on. The plants are then woody and unpalatable, and are not eaten with the same relish as a younger crop.

Assuming average conditions, both in regard to the crop and the lambs, a fair proportion of fats can be drafted off the rape after a period of three to four weeks' grazing. In this respect it must be remembered that the most desirable dressed weight for fat lambs for export lies between 32 lb.

and 36 lb., the overseas demand being for small joints. Another point is that second-grade lambs may be found in almost any weight, a good deal depending on the conformation of the lamb and the amount of condition necessary to give it the proper finish. Also, a perfectly finished lamb may be second-graded for bruising owing to rough handling.

Depending on the district and the crop, rape is used after weaning has taken place. The main object is to keep the lambs from receiving a check; if the other feed is scarce it may be advisable to wean earlier, in other circumstances later. Much depends on the feed available up to the time of weaning.

Rape-scald: This condition, which is sometimes met with, is an inflammation of the skin (dermatitis) affecting the skin of the ears and, in some cases, extending along the back and sides of the body. The ears become swollen and pendulous and inflamed areas appear on the back where the skin becomes thickened and may become detached from the underlying tissues. The condition appears to be due to a photosensitization of the skin due to the sun's rays and is more commonly seen among lambs which have been shorn, the absence of wool leaving the sensitive skin open to the effects of the rays which are responsible. The condition may be seen among other lambs and sheep, but very rarely. Although this condition may be met with and must be mentioned here so that owners may be able to recognize it without undue alarm, the condition is really one of extreme sun-burn. If considered advisable the affected lambs can be moved off the rape for a day or two.

—*J. E. McIlwaine, Live-stock Division, Wellington.*

THE ORCHARD.

Spraying Operations.

In most districts there is a heavy flight of codlin-moth about the middle of February, which must be guarded against by an application of arsenate of lead during the second week of that month. Add Black Leaf 40 if there is any sign of leaf-hopper making its appearance. Powdery mildew—in some districts the worst apple-tree disease we have—will require constant attention by the use of lime-sulphur plus a finely divided sulphur. Such a combination will also assist against black-spot infection of apples and pears. Owing to the dry season so far experienced in most localities the crop is very clean, but growers must not be lulled into a sense of security by this general immunity from black-spot. Protection must be given to leaves and fruit to avoid late infection of "pin-point" black-spot, which is liable to occur as the result of dewy nights and humid autumn weather.

With the low rainfall and high temperatures which have been generally experienced red mite is reported from almost every district to be very aggressive this season. Steps, in some cases drastic steps, must be taken to control it at once, in order to assist the maturing crop and to ensure reasonably clean trees for the coming season. Now, before the winter eggs are laid on the bark of the trees, is the time for such a clearance, and growers are strongly urged to spray immediately, as previously advised, for the control of this pest, which is capable of doing so much damage to the crop and trees.

Orchard Hygiene.

The destruction of material—fruit, shoots, and limbs—infected with such diseases as brown-rot, silver-leaf, fireblight, codlin-moth, &c., should never be neglected however busy the grower may be, otherwise he is only storing up trouble for himself for future seasons. The disinfection of second-hand trays used in some districts is also a wise precaution, especially in those localities where brown-rot is at present not a serious menace.

Cultivation, Irrigation, and Cover-cropping.

Attention is directed to the advice tendered in these notes during the last few issues of the *Journal*, with an especial urge to growers in Central Otago to sow cover-crops and to keep up their irrigation during the succeeding dry months of late summer and autumn.

Budding.

With the decreasing flow of sap and the maturing of the buds, February and March are suitable times for budding. In Northern districts late budding is usually very successful, as the danger of flooding and commencement of growth when the sap is moving freely is over. In the South, where early autumn frosts are liable to occur, it is safe practice not to leave the operation until late in the season. Instances have occurred in Central Otago where trees budded in late March were affected by a frost a night or two after. Considerable loss—up to 90 per cent—was occasioned through the frosting of the buds before a proper union had been made between bud and stock

The main factors to consider in budding are (1) a steady flow of sap in the stocks to ensure, without flooding or commencement of growth, the early knitting together of the cut surfaces, (2) mature wood buds of the current season's growth (avoid taking buds from either end of the shoot), (3) quickness of operation so as to avoid drying out of the cut surfaces of bud or stock, and (4) firm tying of the bud

Harvesting the Stone-fruit Crop.

Growers would be well advised to consider the prices received already for the earlier fruits. This season the difference in price for first-class fruit and that obtained for inferior stuff has been more marked than usual, and with the lower purchasing-power of the public this is likely to be still further accentuated as the rush of the season approaches. Keep the standard high and consistent, and make every endeavour to place the fruit on the market in good condition, free from marks and bruises, and in an attractive package.

Export Preparations.

Packing fo export will have commenced before the next issue of the *Journal* is in the hands of growers, and everything should be in readiness for the coming rush. If the good name which we have built up for our fruit overseas is to be maintained all sources of deterioration must be eliminated. The bigger items are usually well attended to, but some of the smaller factors are liable to be overlooked and will be discussed in next month's notes. In the meantime let every care be taken right from the picking through the various operations, large and small, until the fruit is finally shipped.

—*W. R. Lloyd Williams, Orchard Instructor, Alexandra.*

Citrus Culture.

Cultivation should receive very close attention at this period. The land should be worked to a fine tilth as early as possible, and this maintained. Citrus trees in particular require constant cultivation to conserve moisture, as they make the greatest demand on the soil during the period of minimum rainfall. If it is not possible to maintain a fine tilth on the earth-surface, the trees should be mulched to at least the spread of the branches with rough litter or manure. When mulching one must exercise care and not pile the material up against the trunk, as this is liable to cause decaying of the bark and injury to the tree.

Young shoots which become extended in growth should be pinched back to encourage side lateral growth. If left to mature these shoots often grow to 3 ft. or more before subdivision takes place, and then side laterals grow only on the extremity, leaving an undue length of wood unfurnished By pinching out the point of these shoots as suggested laterals are forced nearer the base and growth encouraged where it is most useful, and not where it is naturally disposed to grow.

Humid conditions suitable for the spread of verrucosis will necessitate a further spray of bordeaux 4-4-40 if the advancing crop is to be maintained clean.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

The Growing Pullets.

SPECIAL attention should now be given to the feeding and general management of the growing pullets, for upon the attention received by them at this period will largely depend the profits to be secured during the winter months. It must be emphasized that to attempt short cuts to early and heavy production is a big mistake. While meat in some form is a most valuable item in the diet of the growing bird, it should be used with the greatest of care, for meat, especially when fed too liberally, may do as much harm when used at the wrong time as it will do good when employed at the right time.

The most harmful effect of overfeeding meat is frequently seen among young stock, which, instead of growing into good-sized and vigorous birds, have been forced to maturity before they have attained anything like the standard weight requirements of the breed they represent. By this it is not implied that size alone should be the main object aimed at, for that can be easily overdone at the expense of the egg-basket. Early maturity is certainly desirable, but only when the bird has attained a complete stage of development which conforms to the standard weight of the particular breed represented. I have frequently seen White Leghorn pullets commence laying when a little over four months old, and even Black Orpingtons which produced at under five months. Obviously such stock are undesirable, chiefly for the reason that when a pullet starts to lay she ceases to grow and will never attain a desirable size for breeding purposes nor produce standard-sized eggs for the market.

The value of a pullet is determined mainly by the number of eggs she will produce in the dear season under adverse conditions and while her product is of good saleable size, not by the fact that she commences to lay at an early age. Therefore, when pullets show indications of prematurity it will be found a wise course to feed meat, meat-meal, &c., sparingly, or perhaps entirely eliminate such forcing foods from the ration during the growing stage; this applies with equal force to skim-milk, milk-curd, &c.

It must be admitted that even in the best-managed flocks some pullets will prove to be more precocious than others, but the former are hardly likely to prove really profitable stock for they are liable to moult just before the dear egg season commences. On the other hand, the well-developed pullet hatched at the right time, and which commences her season of production about April, can usually be depended upon if properly fed and handled to continue laying for the greater part of the year, and after proving a profitable bird in her first laying season, will moult in time to produce a good egg-yield during the following year and eggs of a size desirable for incubation purposes.

Generally speaking, with White Leghorns between six and seven months is the best age for a pullet of a laying strain to start on her season of production, and this may be extended for a month in the case of Minorcas and the heavier breeds. If winter eggs are to be secured in good numbers it is important that the pullets should be in their laying quarters well in advance of the commencement of the laying period.

Changing the quarters of the pullets just before or at the commencement of the laying period is the surest way of bringing on a false moult and thus rendering the flock unprofitable. The pullets should be accommodated in quarters which are roomy and comfortable, but at the same time airy. It must be remembered that the season for high-priced eggs is being more and more curtailed as compared with previous years, and it therefore becomes increasingly important that the pullet intended for winter egg-production should be handled with the greatest care, so that she can be depended upon to lay just when required. Do not experiment, and remember that the pullet has been bred out of its natural season, and is expected to produce her maximum yield of eggs at a time when nature meant that she should rest.

Especially is it necessary in these days of dear foodstuffs to have birds producing a good yield of eggs during periods other than the natural laying season. At the present season there is hardly a poultry-keeper to be met with who will not declare that all his birds are laying well. It is very different, however, in the winter months when eggs are returning the best price; only those who have good stock, hatched at the right time, and who give their pullets never-ending care and attention, can then boast of big egg-yields. Even with pullets hatched at the correct period of the year, draught-proof but well-ventilated houses kept in a thoroughly clean condition, and the provision of ample accommodation for exercise, green feed, clean water, broken sea-shell, sharp gravel grit, and a generous supply of food with a proper proportion of animal food (given separately if possible) are indispensable if winter eggs in large numbers are to be secured.

Day-old Chicks.

One of the most unsatisfactory features connected with the day-old-chick trade is the mistaken idea held by many purchasers that if the young birds fail to thrive and do well they must necessarily have been bred from weak parents. It may be true that chicks are sometimes sent out that are difficult to rear, but before placing all the blame on the supplier of the chicks it would be well for those who experience trouble in this direction to ask themselves if they have not been inviting failure by neglecting some essential detail or leaving too much to the brooder.

The following is a case in point. Recently a number of chickens which had been purchased from a specialist breeder as day-old chicks were brought to me and my advice sought regarding their failure to thrive and make sound development. When I examined the birds the cause was plain at a glance, for they were overrun with insect pests. From inquiries made it was ascertained that the young birds were being reared in a house where adult stock had recently been accommodated, and that the cleaning operations were not as thorough as they should have been before the chicks were placed there. Obviously, to subject the young birds to such conditions was simply courting disaster. Even if chicks are bred from the best birds on another breeder's plant, and not from culls, they must be reared under the best conditions if they are to thrive and develop into profitable stock.

Success in rearing chickens by artificial means depends upon attention to many details, but there is one detail in particular that must be strictly observed, and that is cleanliness. Unfortunately, many people who attempt

to rear artificially hatched chicks have no idea as to what cleanliness really means, and fail to realize that dirt is the forerunner of disease and parasitic infestation.

One of the strongest points in favour of an incubator is that it does not breed vermin, the source of probably one of the heaviest leakages in the business of poultry-keeping. Chickens will sometimes make more or less sound development with the natural mother, even when affected with vermin, but where chickens are in a brooder vermin are practically fatal to their welfare, and especially is this the case with red mite. When growing stock are to be placed into a house where adult birds have recently been accommodated one cannot urge too strongly the necessity for giving the quarters a through cleaning, followed by a good spraying with strong disinfectant, so that the young birds will be safe from the infestation of the vermin which are usually found in the ordinary fowlhouse at this season of the year.

The incubator-hatched chick under ordinary circumstances should go right through its developing stage without having to contend against vermin, and it should be remembered that a young bird receiving a check from this cause will never develop into the best type of adult. Instances could be multiplied where good stock and their owners have been condemned because the purchasers failed to give the birds the proper attention themselves.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Extracting Operations.

By this time, provided weather conditions are favourable, extracting will be in full swing in all districts. There may be two or more extractings during the season, or the honey may be left in the hives till the close of the flow, and the whole crop removed at one time. In the latter case the bee-keeper needs an ample supply of supers and combs, and must watch attentively that the hives do not become honey-bound and the bees commence loafing. The better plan is to have two or three extractings during the season, removing at the first operation all combs in which the honey is wholly or three-parts sealed. When these are emptied and returned to the hives the excluders should be brought into use if they are not already in the hives.

Hot sunny weather should be chosen for the work, as on such days the honey runs freely and the bees are good-tempered. A good plan is to remove the honey in the morning, stacking the supers in the honey-house as they are removed, preparatory to extracting in the afternoon. By this method all stray bees can be removed before the actual extracting commences, and the operator can work quickly and peacefully at emptying the combs till the evening, when the empty combs can be returned to the hives. By the morning the bees will have settled down and returned to the task of refilling. "Keep the extractor running" is a good maxim once the work has commenced, and every hot day should be utilized for gathering the harvest.

Removing Honey from the Hives.

Honey should not be removed from the hives until it is well ripened. When the surfaces of the combs are a half to three-parts capped the honey is usually sufficiently ripe to extract with perfect safety. In Northern districts the practice of taking off "green" honey, to be afterwards ripened in the tanks, has been to some extent carried out, but the humidity of the climate must be the deciding factor. In Southern districts such

procedure would be dangerous, and care should be exercised and only well-ripened honey taken. By taking unripe honey fermentation will often result, rendering it unfit for consumption.

When the time for extracting is at hand the usual practice is to remove the combs one by one, and to brush or shake off the adhering bees. As the combs are relieved of the bees they should be stacked in a super, to be afterwards removed to the honey-house. It is a wise precaution at all times to place a cloth over the combs in the super, and if there are any signs of robbing it is a good plan to use a damp cloth which has been previously immersed in water containing a small percentage of carbolic acid.

Use of Strainers.

Some form of strainer should be adopted to catch the larger particles of wax, dead bees, &c., in the honey as it leaves the extractor and before it finally reaches the tank. It is a simple matter to strain the honey, and yet this important part of the work receives less attention than its importance demands. It should be the aim of every beekeeper to see that his product is rendered as marketable as possible before it finally reaches the customer, and thus create a name for a high-class article. Wax is not a component part of honey, and dead bees are foreign matter, and yet they are frequently found in honey exposed for sale. Honey containing either is not likely to suit the buyer, and its selling-value is consequently reduced.

To ensure all but the smallest particles of wax will be removed the honey should be run through a fine wire strainer, and finally passed through fine cheesecloth before entering the tank. Cheesecloth strainers are cheap and easily made, and should be cleansed after each day's operations. The strainers should be of such construction as to be easily cleaned, and if the cloth is tacked into wooden frames the operation is greatly facilitated. Use cold water when cleansing the strainers; hot water melts the particles of wax, thereby clogging the holes in the cloth, whereas cold water removes all wax from the surface. Hang the strainers up to dry, so as to be ready for use when required.

The Honey-tank.

No part of the apiary equipment is of more importance at extracting-time than a good tank. From the strainers in use it is advantageous to run the honey into a tank, so that the small particles of wax that pass through the strainers will rise to the surface, when they can be skimmed off before finally drawing the honey off at the bottom of the tank. Many beekeepers run their honey direct from the strainers into tins and small packages ready for sale, with the result that the small particles of wax rise to the surface, to the detriment of the honey and its sale. Frequently complaints are made as to the quality of the honey, and not infrequently adulteration is suspected through an excess of these wax-particles rising to the surface. Such honey should not find its way to market, its condition having been brought about by sheer neglect to provide adequate tank accommodation. By allowing the honey to settle in the tank the air-bubbles escape, the small particles of wax rise to the surface, and in dry weather surplus water is evaporated.

The size of the tank to be adopted must be decided by the beekeeper himself, as it is hard to find two with requirements alike in the matter of honey-tanks. He must study his needs and convenience, but in any case the tank should hold enough to enable him to deal with the honey in the hives at the time of extracting.

Cleanliness in the Honey-house.

It should hardly be necessary to point out that the greatest care must be taken in preparing honey for market. However, it is by no means an uncommon thing to come across cases where the beekeeper appears to have lost sight of the fact that honey is a food, and, what is of more importance,

a food which is eaten uncooked. Everything in the honey-house should receive the same attention as dairy utensils The extractor and tank cannot be washed out every day during the season, but they should be thoroughly scalded before commencing operations, and whenever honey is allowed to remain in them they should be covered with clean washing-covers. These cost little, are easily made, and should be very much in evidence throughout the season. On no account should bees, flies, dust, or other foreign matter be allowed to alight on the honey in the tank, and as soon as extracting is finished for the day the extractor should be closely covered with a cloth Finally, as a fitting close to the day's work, the floor of the extracting-room should be washed and every drop of honey spilt during the day removed.

Treatment of Foul-brood.

The work of putting colonies under treatment where foul-brood is detected should not be postponed. The season is a short one, and every effort should be made to winter only clean hives. The risk of having the disease spread by robbing during the off-season, when it is most likely to break out, will lead to endless work in the spring unless the beekeeper is in earnest in checking its spread during favourable conditions. No better plan can be followed than to treat all infected colonies by the McEvoy method during the late flow. Many beekeepers are too ready to postpone treatment, only to find in the spring their hives weak in bees, and consequently in poor condition for successful treatment. No half-measures should be adopted when dealing with foul-brood, and in all cases the " double shake " should be practised if the disease is to be entirely eradicated.

A good plan to follow if any doubt exists as to the complete absence of the disease is to mark all infected colonies, and to leave them to be finally dealt with after the clean colonies are extracted. In any case the combs should be marked with the number of the hive to which they belong, so that when they are extracted they may be returned to the colony from which they were taken. If these precautions are taken the risk of spreading disease by means of wet combs is minimized.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Maintaining Soil-fertility.

A LIFE'S experience devoted to the cultivation of the soil develops an instinct in the judgment of soil-fertility. Smell, sight, and touch contribute valuable evidence in arriving at conclusions, but when an experienced grower states that his land " is turning up badly " he means as a rule a great deal more than he can express. The final ploughing, which is the main feature in the culmination of the preparation of the land for springtime planting, is important in that the cultivator can then estimate the quality of this preparation, for on that more than on anything else the success of the crop depends. The reaction will vary in the case of soils of different kinds, but one that is known to be free from weeds, well supplied with plant-foods, of a dark shade of colour and of a light fibrous texture for a depth of a foot or so, may generally be expected to give good results—that is, if the seed used is of a good strain and the climatic conditions during the season are normal. If any of these conditions are lacking the resulting crop will suffer.

The conditions which are most difficult to maintain in land under continuous cropping, and that are as a rule generally deficient, are those which come under the heading of physical conditions. The soil turns up sticky and lumpy, it dries out quickly, and becomes harsh and dry. Such a soil may be given—and it generally receives—heavy dressings of expensive

fertilizers, but still the crop is comparatively low in quality and quantity. The fertilizers supplied, and much of the natural foods in the soil, are not available to the plant to anything like their full extent. As plants take their food only in solution a constant supply of water is necessary, and soil in a bad physical condition is sticky and stagnant while wet, dries out rapidly, and is wetted again only with difficulty. A constant supply of water and steady soil temperatures can only be maintained by keeping the soil well supplied with humus—material formed by the decomposition of animal or vegetable matter. In addition to the plant-foods it contains there are the carbon and fibre which lighten the soil and give it that spongy condition which retains moisture and keeps it sweet; and whatever foods are present are readily made available in greater quantities.

This difficulty is typical of modern conditions; stable manure upon which growers in the past chiefly relied for humus is not available, and land is often too high-priced to permit it to be devoted for two or three months to the production of green cover-crops for ploughing in, and artificial fertilizers are applied in increasing quantities. If the land is heavy and deep this drawing on the capital, so to speak, may continue for some time as the resources are comparatively extensive; but where the land is inclined to be light the humus present is more quickly used up owing to rapid oxidization, and the bad physical conditions causing sterility quickly arrive.

It is just as well to realize that there is nothing to take the place of humus, and constant cropping, such as is practised by most market-gardeners, cannot be maintained without it, no matter what artificial manures are used. The most that modern research has been able to do as regards this problem is to wet straw and ferment it rapidly to bring it quickly to a desirable state for dressing the land. This is of great help, where straw is available, and further suggests that grass, weeds, and vegetable growth generally growing on waste areas should be cut with a mower shortly before seeding, stacked in a moist condition, and fermented for application to the land at a convenient time. This would have the additional advantage of cleaning up rough corners and should facilitate weed-control.

Apart from such resources of humus, the only other methods generally available are to adopt a rotation which permits the land to be grassed and grazed for three years or so, or to grow green cover-crops and turn them in. The former is an excellent method and specially suited to lands that are rather light. Such a soil is often excellent for the production of early crops, but will not stand the constant cropping done on heavier lands. These latter may sometimes be kept in condition with, say, one good cover-crop turned in in three years. To do that one-third of the area should be cropped in this way each winter. A medium loam over a shingly subsoil—rather inclined to be overdrained—would benefit from a heavy green crop turned in annually.

In estimating the cost and profits under either of these systems, it should be realized that a good supply of humus must be maintained in a soil to keep it fertile, and nothing else can take its place. If this were done a quarter or less of the artificial manures commonly used would be more effective than the larger amount, owing to the better conditions for making them available to the crop. Artificial fertilizers will not take the place of humus.

Vegetable Crops.

Important sowings for this month are Globe beet, Shorthorn carrots, dwarf beans, peas (of an early variety at this season), spinach, salads, and turnips. Harvest shallots and onions as soon as the tops begin to turn yellow; also potatoes as soon as they ripen. The quality of many crops is depreciated by delaying this operation. Do not allow marrows or celery to become dry; a dusting with soot is an excellent insect-powder in the

garden. The celery crop would often benefit from such an application. Most of the spring cabbages and cauliflowers cut during the month of September are sown in February for April planting; these are important crops. Sow now also mild white onions for salads.

Small Fruits.

Preparation of the land for planting berry fruits should be completed as soon as it is available after the present preliminary crops—whatever they may be—are lifted. Cut, carry out, and burn the fruited canes of raspberries and logan-berries. Spray the new canes and bush fruits generally with a mixture composed of bordeaux and arsenate of lead, so that they may be thoroughly clean during the dormant season.

The Homestead Garden.

Last month's notes dealt with shelter and shade trees in the garden selected from our native evergreen plants, which are more suitable than any others for those purposes. A sheltered setting of evergreen trees and shrubs having thus been planned, the more showy climbers and shrubs for foreground planting have to be considered. It would be mere prejudice to suggest that nothing but New Zealand plants should be used for this purpose, but certainly all that are worthy should be included if they are suited to the locality. There are a surprising number of species of high merit which will be better still after some years of careful selection among seedling varieties followed up by vegetative propagation.

When forming this season's planting-plans the following should receive consideration for such positions: Among climbers the white-flowered clematis of early spring, puawananga (*Clematis indivisa*), followed later by the highly scented kaiku (*Parsonsia heterophylla*), and the passion-flower, kohia (*Tetrapathaea tetrandra*), with modest flowers followed in autumn by large orange-coloured fruit of very attractive shape. These climbers are best displayed on evergreen trees of moderate height, with which they thrive on the most agreeable terms.

Among shrubs some of the most showy are *Clianthus puniceus*, the kaka's beak, red, white, or pink; the lace-barks or ribbon-woods, *Hoheria populnea* and *Gaya Lyalii*, which display their large white blossoms in summer; when also the pink and scarlet blossoms of pohutukawa (*Metrosideros tomentosa*) make large sheets of colour. Among the most highly scented is mairehau (*Phebalium nudum*); it is of moderate height and most attractive in summer, when its white, scented flowers bloom. The dwarf tainui (*Pomaderris elliptica*) may be included in this class, also the red manuka (*Leptospermum scoparium Nicholsii*), and that finest of our spring-flowering shrubs and small trees, the kowhai (*Sophora tetraptera*).

The present time is most suitable for planting spring-flowering bulbs and such lilies as the Christmas lily (*Lilium candidum*), which like a moist well-drained loam and to be left undisturbed once it has established itself.

Towards the end of February is the beginning of a short period when sowing-down new lawns is best done in most parts of the country. Where the land has been fallowed during the summer, and occasional cultivation given to destroy weeds, it will have settled down compactly, and comparatively little labour will be required to obtain a clean, consolidated soil with a smooth surface, which is necessary. A shallow tilth should then be obtained by raking the surface and the seed sown evenly in still weather and raked in; ½ oz. to 1 oz. to the square yard is a suitable quantity of seed under average conditions. But the good appearance, which is so admirable in a well-laid lawn, is not merely in a smooth green sward, but also in a well modelled surface with well chosen levels and grades.

—*W. C. Hyde, Horticulturist, Wellington.*

LICENSED MEAT-EXPORT WORKS IN NEW ZEALAND, SEASON 1931-32.

Name and Address of Licensee.	Name and/or Location of Works	Beef-killing Capacity per Day.	Sheep-killing Capacity per Day.	Storage Capacity in 60 lb. Carcasses Mutton.
North Auckland and Auckland.				
Auckland Farmers' Freezing Co., Ltd., Auckland ..	Moerewa ..	200	2,000	100,000
" " " ..	Southdown ..	200	3,000	202,000
" " " ..	Horotiu ..	200	3,000	218,000
Westfield Freezing Co., Ltd., Auckland	Westfield ..	250	5,000	180,000
R. and W. Hellaby, Ltd., Auckand	" ..	200	1,000	50,000
Gisborne.				
Gisborne Refrigerating Co., Ltd., Gisborne	Waipaoa ..	150	3,500	270,000
" " "	Kaiti ..	175	6,000	422,000
Gisborne Sheep-farmers' Frozen Meat and Mercantile Co., Ltd.	Tokomaru Bay	60	3,000	130,000
Hawke's Bay.				
Nelson's (N.Z.), Ltd., Tomoana	Tomoana ..	150	7,000	150,000
Hawke's Bay Farmers' Meat Co., Ltd., Hastings ..	Whakatu ..	80	8,000	140,000
Wairoa Farmers' Co-operative Meat Co., Ltd., Wairoa ..	Wairoa*	..	.	..
Taranaki.				
Thomas Borthwick and Sons (Aus.), Ltd., Masterton ..	Waitara ..	200	2,000	80,000
J. C. Hutton (N.Z.), Ltd., Wellington	Eltham ..	60	..	25,000
Patea Farmers' Co-operative Freezing Co., Ltd., Patea..	Patea ..	150	3,000	180,000
Wellington.				
New Zealand Refrigerating Co., Ltd., Christchurch ..	Imlay ..	200	7,000	203,000
Thomas Borthwick and Sons (Aus.), Ltd., Masterton ..	Feilding ..	100	4,000	153,500
National Mortgage and Agency Co. of New Zealand, Ltd (Head Office, Dunedin)	Longburn ..	80	3,000	60,000
Thomas Borthwick and Sons (Aus.), Ltd., Masterton ..	Waingawa ..	120	5,000	150,000
Gear Meat Preserving and Freezing Co. of New Zealand, Ltd., Wellington	Petone ..	100	10,000	300,000
J. C. Hutton (N.Z.), Ltd., Wellington	Ngahauranga ..	120	3,000	120,000
Wellington Meat Export Co., Ltd., Wellington ..	" ..	120	8,000	240,000
" " " ..	Kakariki† ..	100	2,000	90,000
Marlborough and Nelson.				
New Zealand Refrigerating Co., Ltd., Christchurch ..	Picton ..	30	2,000	30,000
Nelson Freezing Co., Ltd., Nelson	Stoke ..	30	500	50,000
Canterbury.				
Canterbury Frozen Meat and Dairy Produce Export Co., Ltd., Christchurch	Belfast ..	120	5,000	170,000
Ditto	Fairfield ..	..	4,500	100,000
"	Pareora	25	5,000	233,000
New Zealand Refrigerating Co., Ltd., Christchurch ..	Islington ..	50	7,000	178,440
" " " ..	Smithfield ..	50	6,000	300,000
North Canterbury Sheep-farmers' Co-operative Freezing Co., Ltd., Christchurch	Kaiapoi ..	..	4,000	222,000
Thomas Borthwick and Sons (Aus.), Ltd., Masterton ..	Belfast ..	..	5,000	120,000
Otago.				
Waitaki Farmers' Freezing Co., Ltd., Oamaru ..	Pukeuri ..	..	3,800	130,000
New Zealand Refrigerating Co., Ltd., Christchurch ..	Burnside ..	50	3,500	34,609
South Otago Freezing Co., Ltd., Balclutha	Finegand ..	50	3,500	200,000
Southland.				
Ocean Beach Freezing Co., Ltd., Invercargill ..	Ocean Beach ..	50	4,000	120,000
Southland Frozen Meat and Produce Export Co., Ltd., Invercargill	Mataura ..	50	3,000	124,000
Ditto	Makarewa ..	120	3,800	107,000
Tait's Woodlands Meat Co., Ltd., Invercargill ..	Woodlands‡ ..	..	..	..
Totals	..	3,640	149,100	5,582,549

* Not operating at present; disorganized by earthquake and fire in February, 1931. † Not operating. ‡ Canning only.

—*Live-stock Division.*

WEATHER RECORDS: DECEMBER AND CALENDAR YEAR, 1931.

Dominion Meteorological Office.

NOTES FOR DECEMBER.

DECEMBER was, generally speaking, a pleasant month, with abundant sunshine. There were three periods during which large parts of the country received very beneficial rains. Their value was all the greater owing to the fact that they fell in warm weather. In many cases, indeed, they resembled tropical downpours, and were associated with thunderstorms. At date of writing rain is still badly needed in Hawke's Bay and Poverty Bay, and still more in Canterbury and Central Otago. The higher levels are generally in fairly good condition, but the plains are very dry and feed is scarce. In other parts there is ample feed, and the prospects are favourable.

Rainfall.—Owing to the fact that much of the rain came in heavy downpours of a local character the distribution was irregular. On the whole, however, the more exposed portions of the country tended to have a larger amount than the average for December, while in the interior and in eastern districts deficits largely predominated. Nelson Province experienced a wet month, especially the area round Tasman Bay. Nelson City had 11 in., the highest total recorded in any single month since 1883. North Auckland and parts of the East Cape districts also had much more than the average. The deficits were most serious in Poverty Bay, Hawke's Bay, the Wairarapa, and in Canterbury. In the last-mentioned province the amounts were approximately half only of the December normal.

Temperatures.—There were some exceptions, but over most of the Dominion the mean temperature was high for December.

Winds.—A considerable amount of northerly wind was experienced, especially in the middle of the month, but, since it was generally north rather than north-west, its character was not so unpleasant as usual. In the southern half of the South Island, however, there was a considerable proportion of westerly wind, which accentuated the effect of the dry weather.

Sunshine.—The number of hours of sunshine recorded was generally high, but was below the average at Hokitika and in parts of Canterbury.

Storm Systems.—Most of the rain during the month was caused by storms of cyclonic type, and occurred during three periods. The first was associated with a cyclone which was deep when over the Tasman Sea on the 6th, but which decreased in intensity next day, and, moving north-eastwards, crossed the Dominion at its northern extremity. Rain was widespread and over the North Island almost general, but the falls were in may cases light or moderate. On the whole, it was rather disappointing.

The second spell occurred about the middle of the month. A series of shallow cyclones came from the westward between the 13th and the 21st. At one stage there were as many as five centres in procession. From the 14th to the 17th pressure was high at Chatham Island, and the combination of circumstances was favourable for heavy rain. Strong northerly winds blew, gales being experienced in many parts, especially of the North Island. General rains fell, and the totals for the whole period were practically everywhere heavy. The fact that they were warm rains added to their value. On the 18th thunderstorms occurred in many places, and there were some rainfalls of the nature of cloud-bursts. Flooding was caused by such rains at Masterton, and at Earnscleugh in Central Otago. Similar phenomena were experienced at Dusky, in Southern Otago, on the 16th, and in Taranaki and Golden Bay on the 20th.

The third rainy period was from the 22nd onward. A cyclone was centred east of Tasmania on the 21st, but thereafter the weather gradually approached the westerly type. Heavy rains occurred in many parts of the South Island from the 22nd to the 24th. Over the North Island precipitation was mainly light and scattered. Northerly gales blew on the 23rd, some damage being done in the Manawatu and Wairarapa districts.

RAINFALL FOR DECEMBER AND CALENDAR YEAR, 1931, AT REPRESENTATIVE STATIONS.

No.	Station.	December, 1931. Total Fall.	Number of Wet Days.	Maximum Fall.	Average December Rainfall.	Calendar Year. Rainfall in 1931.	Average Rainfall.
			North Island.				
		Inches.		Inches.	Inches.	Inches.	Inches.
1	Kaitaia	4·27	11	1·68	2·63	33·68	58·07
2	Russell	4·86	8	2·21	2·61	40·59	51·52
3	Whangarei ..	3·88	12	1·18	3·07	49·18	62·27
4	Auckland ..	3·45	10	0·90	2·93	49·34	44·85
5	Hamilton ..	1·65	9	0·88	3·69	42·06	50·88
6	Rotorua ..	1·51	6	0·73	3·89	43·87	55·72
7	Kawhia	2·52	10	1·10	3·43	57·02	54·33
8	New Plymouth ..	4·43	11	1·41	4·38	55·82	60·56
9	Riversdale, Inglewood	7·41	10	1·73	7·69	103·49	105·01
10	Whangamomona ..	3·51	5	1·27	5·96	81·81	78·86
11	Eltham	3·47	8	0·93	4·08	49·64*	56·45
12	Tairua	3·59	9	2·52	4·60	47·54	66·78
13	Tauranga ..	3·20	11	1·93	3·75	40·63	53·51
14	Maraehako, Opotiki	6·16	10	4·46	2·81	51·87	53·61
15	Gisborne ..	0·87	9	0·23	2·37	26·58	45·85
16	Taupo	2·67	10	0·94	3·28	37·00	45·11
17	Napier	2·12	10	0·56	2·35	21·19*	35·90
18	Hastings ..	1·34	11	0·42	2·08	23·38	33·09
19	Taihape	3·01	11	0·87	3·38	37·12	37·77
20	Masterton ..	..	..	..	2·94	..	38·97
21	Patea	4·12	11	0·79	3·66	51·90	45·17
22	Wanganui ..	3·84	10	0·94	2·72	37·87	36·44
23	Foxton	2·43	11	0·65	2·79	32·85	33·28
24	Wellington ..	2·70	10	0·87	2·84	39·49	41·08
			South Island.				
25	Westport ..	8·43	14	2·30	8·45	101·78	96·80
26	Greymouth ..	7·21	16	2·10	8·72	114·40	101·17
27	Hokitika ..	8·34	17	1·70	10·63	105·48	116·35
28	Ross	12·84	16	3·45	12·34	139·55	137·98
29	Arthur's Pass ..	13·81	8	3·83	15·23	184·93	164·07
30	Okuru	11·22	14	3·36	11·42	143·72	147·79
31	Collingwood ..	13·20	9	4·32	7·88	89·52*	97·16
32	Nelson	11·00	9	3·64	2·56	36·35	37·94
33	Spring Creek ..	2·62	8	0·70	2·19	27·09	31·19
35	Hanmer Springs ..	1·77	6	0·61	3·63	42·05	41·83
36	Highfield, Waiau ..	1·45	5	0·75	2·72	29·45	33·93
37	Gore Bay ..	0·36	5	0·22	2·85	28·77	31·64
38	Christchurch ..	0·53	10	0·22	2·19	17·75	25·21
39	Timaru	1·34	12	0·32	2·51	15·61	22·78
40	Lambrook, Fairlie	0·71	8	0·18	2·65	16·42	25·21
41	Benmore, Clearburn	2·19	12	0·57	2·30	22·30	25·15
42	Oamaru ..	1·93	12	0·57	2·26	17·23	22·18
43	Queenstown ..	2·39	9	1·07	2·57	37·13	30·69
44	Clyde	2·63	8	1·32	1·79	17·26	15·32
45	Dunedin.. ..	2·63	15	1·08	3·57	32·86	37·20
46	Wendon ..	4·30	10	1·20	2·72	30·38	30·23
47	Invercargill ..	2·57	16	0·65	4·15	42·15	45·95
48	Puysegur Point ..	8·32	25	1·48	7·01	84·87	86·11
49	Half-moon Bay ..	4·14	15	0·88	5·02	63·21	59·56

* Eleven months only: January missing, Eltham and Collingwood; February missing, Napier.

—*Wellington, 6th January, 1932.*

LIVE-STOCK IN NEW ZEALAND, 1931.

Unless otherwise specified, the enumeration is at 31st January.

Land District.	Horses.	Cattle (including Dairy Cows).	Dairy Cows.		Number of Sheep shorn, 1930–31.	Number of Lambs tailed, 1930–31.	Sheep (including Lambs) as at 30th April, 1931	Pigs.
			In Milk.	Dry.				
North Auckland	32,177	628,096	264,291	19,906	1,132,923	541,702	1,220,277	76,184
Auckland	45,957	972,617	452,905	25,560	1,697,827	983,405	1,669,573	154,208
Gisborne	17,290	373,472	41,621	4,121	3,024,233	1,242,738	3,079,252	18,104
Hawke's Bay	14,448	243,007	52,230	4,709	2,955,327	1,381,017	2,987,609	14,791
Taranaki	18,976	420,009	220,213	13,530	1,000,074	521,984	965,255	50,043
Wellington	38,383	761,631	213,549	15,756	5,869,959	3,039,524	6,058,943	69,836
Nelson	6,372	70,031	27,332	2,180	396,059	154,831	472,397	13,713
Marlborough	6,613	48,868	15,953	1,124	1,053,852	441,111	1,133,797	6,393
Westland	2,261	45,128	12,652	1,365	76,521	54,401	93,462	5,577
Canterbury	56,111	190,322	73,759	4,928	4,707,688	2,949,510	5,410,909	39,417
Otago	32,148	145,323	53,113	4,058	3,481,235	1,767,406	4,051,920	17,456
Southland	25,007	182,021	71,614	4,864	2,178,591	1,450,680	2,649,062	10,472
Dominion totals ..	295,743	4,080,525	1,499,532	102,101	27,574,289	14,528,309	29,792,516	476,194
Totals, 1930 (or 1929–30)	297,195	3,770,223	1,389,541	51,869	26,999,410	14,887,599	30,841,287	487,793

NOTE.—Statistics for asses and mules and goats were not collected in 1931.

—*Census and Statistics Office.*

CROP AREAS AND YIELDS, SEASONS 1930-31 AND 1929-30.

Crop.	1930–31.		1929–30	
	Area.	Average Yield per Acre.	Area.	Average Yield per Acre.
	Acres.		Acres	
Wheat—				
Grain	249,014	30·44 bushels	235,942	30·68 bushels.
Chaff, &c. ..	3,000	2·02 tons	1,491	1·29 tons.
Oats—				
Grain	87,152	38·74 bushels	67,722	44·33 bushels.
Chaff, &c.	223,869	1·64 tons	190,072	1·65 tons.
Barley—				
Grain	23,952	34·97 bushels	18,229	41·42 bushels.
Chaff, &c.	925	1·91 tons	402	2·05 tons.
Maize—				
Grain	7,178	44·20 bushels	7,957	47·50 bushels.
Ensilage	421	4·56 tons	695	3·75 tons.
Peas (for threshing) ..	10,558	22·86 bushels	9,855	29·86 bushels.
Beans (for threshing) ..	140	14·19 bushels	171	21·13 bushels.
Linseed (for threshing)	12,200	7·16 cwt.	7,757	9·07 cwt.
Rye-grass seed—				
Perennial	35,851	367·42 lb	24,366	407·74 lb.
Western Wolths and Italian	12,091	452·56 lb.	5 719	507·71 lb.
Cocksfoot seed ..	14,001	189·47 lb.	11,729	171·37 lb
Chewings fescue seed ..	10,593	220·24 lb	9,808	246·37 lb.
Crested dogstail seed ..	3,312	173·07 lb	3,404	243·51 lb.
Red clover and cow-grass seed	3,323	192·55 lb.	4,703	221·14 lb.
White clover seed ..	3,339	170·27 lb.	3,710	163·04 lb.
Other grass and clover seeds	6,674*	91·47 lb	3,446	91·01 lb.
Grass and clover ensilage	114,301	3·33 tons	380,898	2·12 tons.
Grass and clover hay ..	295,285	1·92 tons		
Lucerne hay or ensilage	33,502	..	31,690	..
Potatoes	28,459	5·32 tons	23,214	5·60 tons
Green fodder crops ..	247,711†	..	203,438	..
Turnips	493,902‡	..	475,254	..
Mangolds	10,706	..	10,519	..
Onions	771	7·52 tons	870	11·80 tons.
Hops	634	§	598	1,409·46 lb.
Tobacco	932	775·03 lb.	1,073	..

* Includes 5,158 acres of brown-top which yielded 71·68 lb. per acre. † Includes wheat, 205 acres; oats, 56,530 acres; barley, 6,157 acres; maize, 4,511 acres; millet, 1,303 acres; rape and or kale, 167,924 acres; unspecified, 11,081 acres. ‡ Includes 53,688 acres of turnips and rape mixed. § Not available.

—*Census and Statistics Office.*

Dairy Cattle with Foul-in-the-Foot.—The annual report of the Live-stock Division for 1930–31 refers to this trouble as follows: "A considerable number of cases have been seen in all dairying districts and consequently a good deal of monetary loss has resulted therefrom due to the fact that an animal contracting the complaint is practically useless as a dairy unit during that season. Treatment is laborious, and in the majority of cases is not carried out. As this disease is contracted through injuries in the region of the hoof, it should be the aim of every dairy-farmer to prevent such wounds by removing from the yards and roadways all such material as will injure the feet. To prevent infection all yards, &c., should be kept free from dirt, and affected stock should be isolated until all discharge has ceased."

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

CONTROL OF PIRIPIRI.

"SETTLER," Norsewood :—

Could you inform me which is the best way to destroy or prevent the growth of bidibidi [piripiri] where ploughing cannot be done. In two of my paddocks where the grass is short it is increasing, and no animal will eat it.

The Fields Division :—

The development and increase of piripiri in a pasture is due to the weakening and opening-up of the sward and the general grazing management. The fact that the grass is short, and is probably kept continuously short and lacks vigour, is responsible for the successful competition of the piripiri. If there is sufficient grass remaining and it is practicable to top-dress you should do so, spelling the pasture completely for a time. The growth of grass will eventually lift the runners of the piripiri off the ground. Cattle should then be used to clean out the growth. Under such conditions a great amount of the weed will be eaten or pulled up. If after this treatment a certain amount of the piripiri remains, the spelling and grazing should be repeated with cattle from time to time until the weed is fully controlled.

BLOW-FLY TRAPS FOR THE FARM.

"INQUIRER," Tuakau :—

In the December number of the *Journal* a note in the "Farm" section speaks of fly-traps for controlling blow-flies. Would you kindly explain what the traps are and how operated ?

The Live-stock Division :—

There are several types of blow-fly traps on the market. One which has been very successfully used in Marlborough during the past year is the "Meteor," made in Australia. This consists of a clear glass gourd-shaped broad and squat bottle 12 in. to 15 in. high and about the same breadth, with a 3 in. or 4 in. opening at the top, and one of from 5 in. to 6 in. in the under part, the bottom being drawn up in a curve to the bottom orifice, leaving a receptacle inside the glass trap about 4 in. deep round its entire circumference for the holding of water, with which it requires to be filled. The bottle sits on four glass knobs or buttons each about ½ in. high, which leaves a space underneath through which the flies enter the trap. The bottle is set upon a petrol-tin or other similar receptacle in the top of which a circular hole about 6 in. in diameter has been made. A generous supply of liver, with about 1 quart of water, is placed in the tin, and the bottle (which requires to be filled with plain water *only*) is placed on top of the tin over the hole. The hole at top of the bottle is then blocked to prevent the escape of the flies by tying a piece of sacking over it or by inserting a suitable plug or cover. This is the only baiting necessary, as once the bottle gets full the dead flies become the bait and are said to be the most alluring of all. Subsequent operations are to leave the bottle even if brimming over until the flies start to blow their own dead inside the bottle, then empty it into a second tin prepared in the same way. Rinse the bottle out into the second tin and place on top filled with fresh water. The first tin can then have its contents, which by then comprise both flies and maggots, destroyed either with boiling water and caustic soda, or by sprinkling with arsenical sheep-dip powder and letting stand for a time. The destruction of the flies and maggots in the tin must be effectively done, and farmers report that to do this quickly is not so easy as it seems. When the bottle is again full it is emptied into the first tin and so on from time to time. Kerosene should not be used near the trap, as it has the effect of driving away the flies. As the water evaporates quickly if left in the sun it is preferable to place the trap in the shade. Some farmers have used a home-made adaptation of this trap with good results, and various other "notions" of the sort may be met with.

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GRASSING EXPERIMENTS ON HILL COUNTRY IN WHANGAMOMONA COUNTY.

(Continued from October.)

E. BRUCE LEVY, Agrostologist, Plant Research Station, Department of Agriculture, Palmerston North.

2. The Secondary Burn.

IN the country under review failure of the primary-burn pasture sowings means secondary growth in one form or another. According to the measures adopted, and on the varying success in forming a pasture sward, depends the nature of the secondary growth that puts in an appearance.* Possible methods of dealing with these classes of growth were outlined in the *Journal* for June, 1927, and after four years' additional study I am more firmly convinced that the fire-stick and the seed-bag should supersede crushing by stock. Manurial top-dressing after seeding, wherever practicable, makes the work of subsequent control by stock surer and easier, and to this end also fences are imperative.

THE GRASS-SEED MIXTURE.

The outstanding feature of the regrassing work in the Whangamomona country is the unqualified success, after eight years' trial, of brown-top (*Agrostis tenuis*), Lotus major, and Danthonia pilosa. Over eighty species of grasses and clovers have been tried there, but the final seed mixture might well consist of three—brown-top, Lotus major, and Danthonia pilosa. As in the case of the primary burn, however, there is an initial phase of relatively high fertility due to the ash, and it is sound to include in the seed mixture some species that will establish rapidly and produce during that comparatively long establishment period of brown-top, Lotus major, and Danthonia pilosa. Perennial rye-grass, crested dogstail, and white clover are the best species to use for this purpose. Also, if top-dressing is possible, and for those better slopes, hollows, and places where stock camp, it will be found, provided good perennial strains are used, that these high-production species more

* See this *Journal* for September, 1923, for order of development of secondary scrub and secondary-forest associations.

FIG. 1. BROWN-TOP, LOTUS MAJOR, DANTHONIA PILOSA SWARD ON ONE OF THE EXPERIMENTAL SOWINGS.

These three species are fundamental to the regrassing of secondary-growth country of the Whangamomona type Crested dogstail, white clover, and rye-grass are also important for the early phase, and for the easier and better aspects, or where top-dressing is practicable. (Compare Fig. 10.)

[*Photo by E. Bruce Levy.*

than hold their own with brown-top, Lotus major, and Danthonia pilosa. Again, particularly in dealing with bracken-fern burns, early establishment gives earlier control by stock in virtue of the greater amount of feed produced.

The following seed mixture is recommended, as the outcome of eight years' trial, for all manner of secondary-growth burns of the Whangamomona type of country :—

	lb.
Perennial rye-grass	8
Crested dogstail	4
Brown-top	2
Danthonia pilosa	3
White clover	1
Lotus major	1
Total per acre	19

In logging up burns or secondary burns where much timber is burnt 4 lb. of cocksfoot may be added to advantage. On some of the harder country 3 lb. of Chewings fescue and ¼ lb. of yarrow may be added, and the rye-grass and crested dogstail somewhat reduced.

I would again, however, like to emphasize the necessity of brown-top, Lotus major, and Danthonia pilosa. Where it is necessary to sacrifice some efficiency in regard to the seed mixture on account of cost, on no consideration should the brown-top, Lotus major, and Danthonia pilosa be stinted. Seconds of rye-grass, containing some white clover and suckling clover, may be used as a filler in order to spread the brown-top, Lotus major, and Danthonia pilosa, and it is along these lines that the sacrifice should be made. Crested dogstail is not absolutely essential, but it will be missed during the first three years at least, and for a much longer period if top-dressing at a later date is practicable. It must be remembered that control of the secondary growth to follow is largely dependent on the sward secured, and that the better the sward the easier the control.

Strain in Relation to Primary and Secondary Burn Seed-mixtures.

As in the case of all permanent-pasture seed-mixtures, strain in those for surface-sowing needs close attention. In both primary and secondary burns the failure of any one species through using wrong types, or the wrong seed, may have a permanent detrimental effect on the area being sown. The following notes, giving the strain or origin recommended as an outcome of experimental sowings in each species, should be carefully applied :—

Perennial rye-grass : Use certified New Zealand perennial rye-grass. The false perennial types are no better than Italian rye-grass.

Cocksfoot : Any cocksfoot of New Zealand origin. Imported Danish has 1 per cent. of seeds stained red.

Crested dogstail : Any New Zealand or imported seed. No superior type of crested dogstail on a commercial basis has yet been located.

Brown-top : Southland, Otago, Canterbury foothills, Wairarapa, and Waipu are all good types. The dry-land type harvested on the light arable Canterbury plains should not be used for these hill-country sowings.

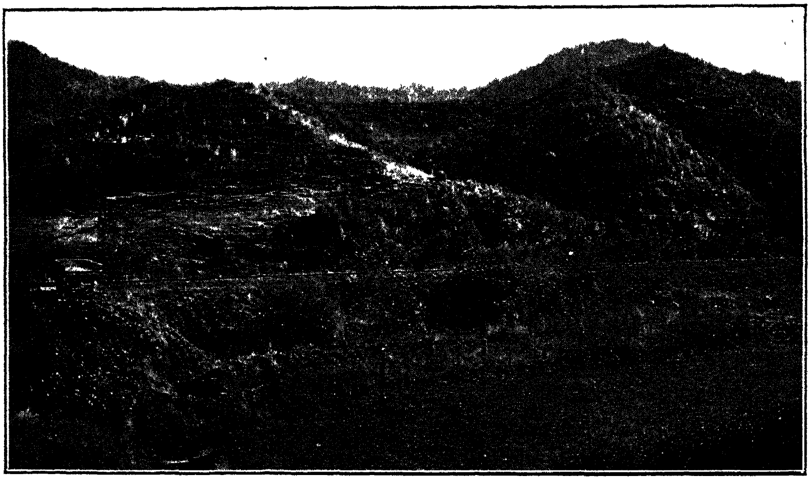

FIG. 2. ONE OF THE EXPERIMENTAL AREAS IN 1924, BEFORE WORK COMMENCED.

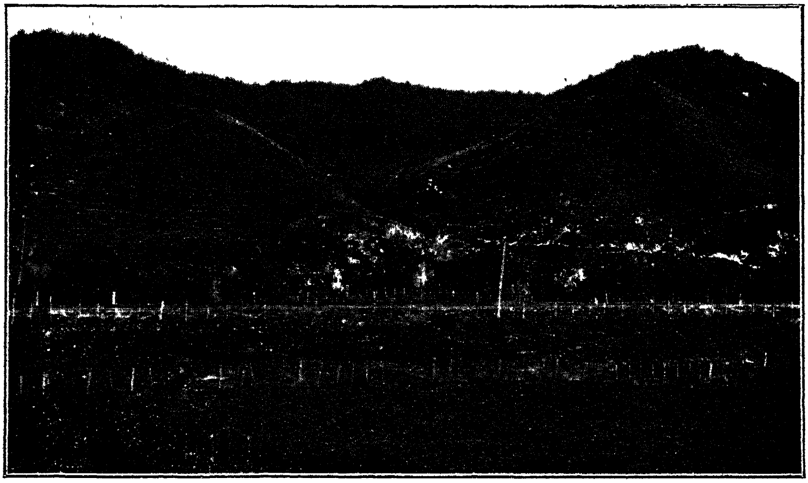

FIG. 3. THE SAME AREA AS IN FIG. 2 IN 1930.
The area is here virtually free of secondary growth and is well grassed. Top-dressed three times since 1924 and sprayed once with arsenic pentoxide.

[*Photos by E. Bruce Levy.*

Danthonia pilosa: Best results have been secured from Canterbury seed, largely owing to superior germination compared with Hawke's Bay and Auckland seed.

White clover: Certified New Zealand white clover, when this becomes more easy to secure, should give best results, but trials at Whangamomona of this type have not been down sufficiently long for

forming a definite opinion. Failing certified white clover, use ordinary New Zealand white, but avoid any imported white clover except Kentish wild white. The price of the latter, however, is prohibitive.

Lotus major: Southland Lotus major is the best, although unfortunately only small supplies are available. Imported Lotus major is quite satisfactory. Auckland-grown Lotus major needs careful buying because of high impurity content, particularly of Lotus hispidus, which has proved quite useless as a substitute for Lotus major.

No seed mixture, however, that could possibly be devised in itself will control secondary growth. The predisposition of the class of country under review to run to forest is too strong, and these secondary growth associations must be recognized as stepping-stones back to forest. Natural grassland associations are possible without man's assistance only where scrub-land or forest is impossible owing to climate. The act of felling and burning the forest does not alter one whit the urge of the country to afforest itself. It simply sets back the successional development, or converts what one may term a stable climax association into one of flux with all the inherent vigour of youth and opportunities for development according to the habitat conditions meted out.

The Factor of Light and Shade in Sward Development.

The grass sward to develop must have light. Cocksfoot to a point makes least demand in this respect, while Lotus major, and to some extent brown-top, by stem elongation, reach to the light from within moderately low-growing secondary growth such as hard-fern and short bracken, and in this capability lies partly their great value on secondary-growth country. But taking the grass sward as a sward it cannot tolerate dense shade. Shade is the basal factor underlying the competition concept. One species in a grass sward or in a forest's successional development gives way to or holds mastery over the other according to shade intensity within the association, the species that overshades the others asserting dominance.

In sown grasslands, apart altogether from secondary-growth control, the factor of light and shade governs markedly the composition of the pasture sward. In phases of secondary growth this light-and-shade factor stands out extraordinarily clearly. Close and continuous grazing admits intense light to the soil-surface; the palatable plants are severely pruned and are weakened under this system of grazing, and light-demanding, unpalatable secondary growth, such as piripiri (hutiwai), manuka, and hard-fern, readily establish. If the sward is allowed to rise it shades the ground surface, the trailing stems of piripiri rise off the ground to the light, and stem-rooting is inhibited. The surface stolons of hard-fern are retarded when shaded, and perhaps one of the most noticeable features of the experimental work is the comparatively small spread back of hard-fern against a good sward that is periodically allowed up, as against the rapid spread back against a weak open sward or one that is continuously eaten to the ground. In one experimental paddock two years ago a portion—3 to 4 acres in extent—was fenced off and has since run dairy cows. A square chain of hard-fern had been left in this area as a control plot. Under two years' light grazing by

FIG. 4. ONE OF THE EXPERIMENTAL AREAS IN 1924, BEFORE WORK COMMENCED.

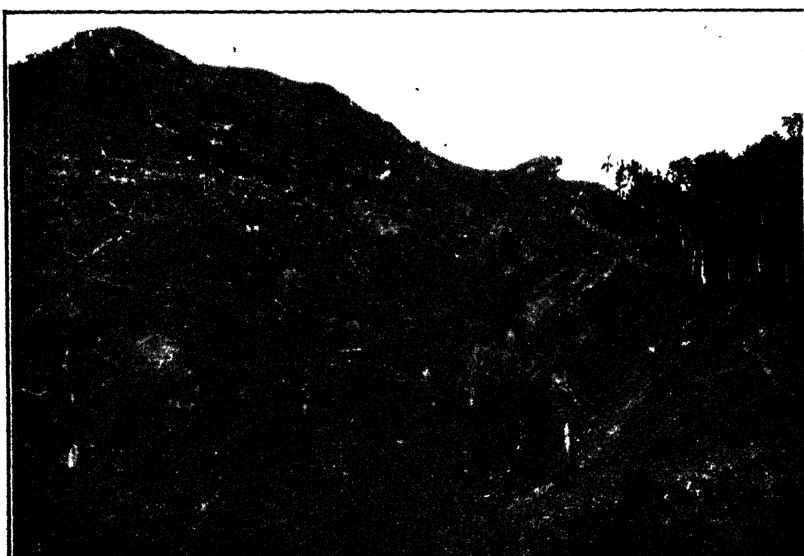

FIG. 5. THE SAME AREA AS IN FIG. 4 IN 1930.

Well grassed, dominantly brown-top, Lotus major, and Danthonia pilosa. Top-dressed once since 1924, and some clearing of patches done in 1928.

[*Photos by E. Bruce Levy.*

dairy cows this control area of hard-fern is now considerably reduced, and the fern has lost all its aggressive vigour.

Shading the ground-surface by a greater and higher sward development, therefore, decidedly prejudices the chances of both piripiri and hard-fern, and, further, greatly inhibits manuka establishment from seed. One has only got to recall to mind the dense manuka patches that occur on slips, the seed establishing there in full sunlight while the ground is yet bare of other vegetation. Tall shading entirely eliminates hard-fern after a period of time, but unfortunately such shading also eliminates the grass sward. Bracken-fern subdues hard-fern by its taller growth. Bracken-fern in turn is subdued by yet taller growths, such as manuka and wineberry.

This but serves to point the way to sward development and to emphasize the impotence of low-growing grasses against taller-growing secondary growth. In order to make a sward that taller growth must be destroyed, or so reduced that light can freely play on to the grass sward itself.

Grass Species persistent among Secondary Growth.

In secondary-growth control one realizes the utter impossibility of totally suppressing all such growth from all aspects of the farm, or even of one paddock, simultaneously. The better areas and lower slopes are fairly readily controlled because there is better grass there to keep stock working the area. In the bringing in of secondary-growth country, therefore, one must anticipate a certain amount of return growth after the fire on the more difficult aspects. For these aspects pasture species that can withstand a certain amount of shade and can persist for a reasonable time in the cover of the secondary growth are of extreme importance. Lotus major stands out pre-eminently successful in this respect. Brown-top, and to a lesser extent Chewings fescue and Danthonia pilosa, can persist for some time among the secondary growth provided this is not too dense, and the value of this persistence is seen when these areas are again fired. The Lotus major, brown-top, Chewings fescue, and Danthonia pilosa withstand excellently the heat of the burn, and with the return of light to their crown tiller well and provide a draw for stock earlier than can be secured by reseeding.

This principle of getting into the country grasses and clovers that can persist among the secondary growth once this gets away, and that can carry a fire well and provide fresh feed soon after the burn, is fundamental to the ultimate control of secondary growth on country too difficult to top-dress and too dangerous to force cattle on.

In the course of the experimental work under review several areas, owing to difficulty of controlling stocking through lack of fences or due to abandonment of the farm, became overrun again with secondary growth. These areas on again being fired and stocked have cleared up far easier, and are being held more easily than hitherto, because of the Lotus major, brown-top, and Danthonia pilosa that was established on the previous burn and which persisted among the return secondary growth, also which came away rapidly after the second clearing up. A third, fourth, or even a fifth clearing up may be necessary, but the important thing is that with plants persisting in the secondary growth

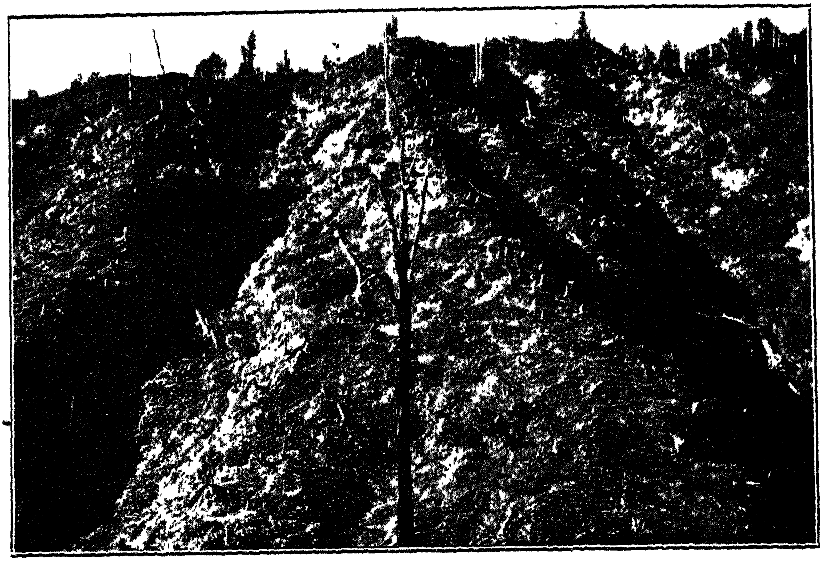

FIG. 6. ANOTHER OF THE EXPERIMENTAL AREAS IN 1924 BEFORE WORK COMMENCED: DOMINANT HARD-FERN, PIRIPIRI (HUTIWAI), AND WEAK TURF.

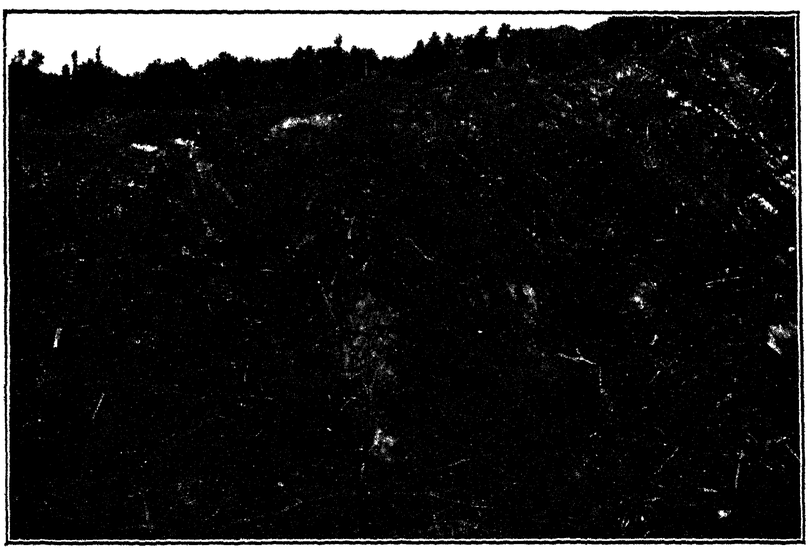

FIG. 7. SAME AREA AS FIG. 6 IN 1930, BUT MORE DISTANT.

The area is here practically free of secondary growth; dominant brown-top, Lotus major, and Danthonia pilosa, with some Chewings fescue, crested dogstail, white clover, rye-grass, and piripiri. Top-dressed three times since 1924, burnt and part sown in 1928, and sprayed twice.

[*Photos by E. Bruce Levy.*

there is no need to spend more on seed of those species already established there. In the case of the sowings made in Whangamomona prior to 1923 where rye-grass, cocksfoot, and white clover were the main species used, once these weakened, as they invariably did in the second year, there was nothing to compete against the encroaching fern, nothing to draw stock, and nothing to come back once that area was again fired. No material progress was possible, and the ever-recurring expense of seeding the secondary burn proved altogether too expensive. Lotus major and brown-top were introduced there by some settlers prior to the experimental sowings, and Danthonia pilosa was slowly spreading, but never encouraged. Actually what the experimental sowings have done is to greatly hasten the widespread acceptance of brown-top, Lotus major, and Danthonia pilosa as the basis of the sward for that class of country, and the adoption of this from results already secured has put new heart into the settlers, for they are able now to see a definite improvement in the grass cover and a definite slowing-up in return of secondary growth. Moreover, what secondary growth comes away is more readily controlled with the brown-top, Lotus major, and Danthonia pilosa that persist among it.

This improvement in the grass sward and in its density compared with the poor, open, original sward consisting mainly of stunted cocksfoot, sweet vernal, stunted Yorkshire fog, rosette and creeping weeds, is a most marked feature. Patches sown eight years ago are as easily recognized to-day as they were the first and second year after burning and seeding—close dense swards of brown-top, Lotus major, and Danthonia pilosa—with some crested dogstail, white clover, and rye-grass still persisting. I view this close dense sward persisting and in many cases improving after eight years a crowning success of the experimental work not only in the amount of feed such swards produce, but in making the country relatively safe against reinfestation of blown fern spores or inbrought seeds. The open sward previously existing afforded easy establishment for manuka, piripiri, and, in the shady aspects, for bracken and hard-fern spores to become established.

In the results of these experiments the plant ecologist, whose work it is to harmonize the plant population with its habitat, has every cause for satisfaction. Nature on those selfsame hills prior to the felling of the forest had harmonized the tree population with habitat. In the various forms of secondary growth arranged again according to habitat there is further harmony. The possibility of grassing that country lay only in the establishment of a grass sward that was in harmony with each and every aspect. The seed mixtures now recommended for hill country burns in Whangamomona and similar country are as sound as is possible to make them with the species of grasses and clovers at present at our disposal.

Time for Burning and Sowing.

The autumn is the best time for burning and sowing, and the later the burn can be left in the autumn the better. Where possible, seed should be sown as soon after the burn as practicable, except in the case of midsummer burns, when sowing is better delayed until about the middle of March. The prime purpose of the burn actually is to get a seed-bed, and that bed should be made ready at the most favourable time for the seed to germinate and establish. The seeding of

FIG. 8. SLOPE BURNT AND SOWN IN 1925, PHOTOGRAPHED IN 1930.
Top-dressed twice and sprayed once. Brown-top, Lotus major, and Danthonia pilosa dominant.

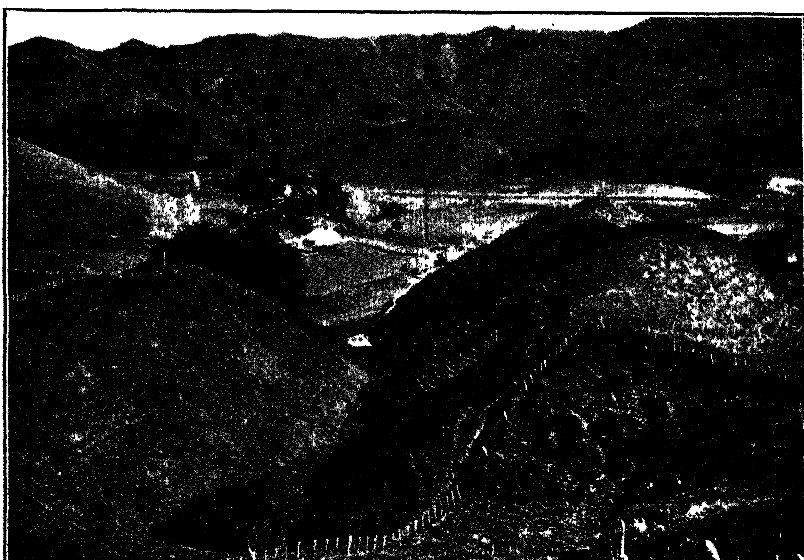

FIG. 9. GENERAL VIEW SHOWING THREE EXPERIMENTAL AREAS.
In foreground 6-acre paddock sprayed, burnt, and sown in 1928; differentially top-dressed in 1929 and 1930. In mid-distance 20-acre paddock sprayed once and cleared up; top-dressed three times since 1924. In mid-background 30-acre area burnt and sown in 1926; top-dressed twice up to time of photo. Carrying-capacity since 1926, three to four sheep per acre.

[*Photos by E. Bruce Levy.*

January and February burns straight after burning is a gamble. If the remainder of the summer proves wet an excellent strike results, but if there is sufficient moisture to germinate the seed and then this is followed by hot, dry weather, the seeding will be a failure. In country like Whangamomona, however, the settler is loath to lose any good opportunity to burn, even spring burning being sometimes practised. There is no doubt seed sown in March on a bed burnt in January or early February gives a very slow and poor establishment compared with the same seeding made on a recent burn provided the weather conditions are favourable for establishment in the latter case. I am inclined to the opinion that where early summer burns are made it is better to leave them until the middle of March, and if the ash has gone to apply a manurial top-dressing as soon as germination is effected. A weakly establishing plant can be strengthened by manure, but a shrivelled-up seedling is gone for good.

Spring burns really should never be made, but if they are it is advisable to sow straight away. In the case of hard-fern the ground is never sufficiently dry in the spring for the fire to roast the rhizome, and within a few weeks there is a new crop. Also in the case of bracken-fern new fronds appear so fast in the spring that stock have to be crowded on before the new sowings are sufficiently well established. In the autumn, if burning weather at all is experienced, the ground is dry and surface rhizomes suffer more severely. Again, in the case of bracken, there is no immediate return of fern fronds to worry about, and the newly sown seed has every chance to become well established before it is necessary to crush hard in the following spring. In a wet season no burning at all should be attempted, as this only ruins the chance of a good sweeping burn once a good burning year comes. The same may be said also of all spring burning. However, once there is established throughout the secondary growth sufficient brown-top, Lotus major, and Danthonia pilosa to come away without further sowing, every available opportunity should be taken—spring or autumn —to remove the shade of the secondary growth by firing or crushing.

Manurial Top-dressing of Hill Country.

The experimental work has shown definitely that control of secondary growth is more certain and can be done with less harm to stock if the area, when sown and the sward established, is also top-dressed with manure. The secret of success, particularly in dealing with bracken-fern, is a high concentration of stock from the beginning of November to the middle of January. If there is present on the area during this period a good flush of grass more stock can be maintained to nip or break off the fern fronds in the curl stage, and thus control is secured without undue forcing. The drawing of stock on to the area rather than forcing certainly appeals as the better practice both for man and beast. The top-dressing of any fern or scrub growth that could be fired and sown down is not recommended. The experiments have shown that, given the same money, to spend on burning and seeding prior to top-dressing is preferable to manuring fern and rubbish as an incentive to draw stock on to crush.

At the present time the Whangamomona sowings are comparatively young, and both brown-top and Lotus major thrive well, the Danthonia

FIG. 10. TOP-DRESSED SWARD SOWN IN 1924.

Dominant white clover, brown-top, and Lotus major, with some crested dogstail and rye-grass. Remnants of hard-fern showing, but spread back against such a turf will be slow. Compare Fig. 11.

FIG. 11. VOLUNTEER SWARD AFTER A BURN.

Sweet vernal, catsear, suckling clover, and stunted Yorkshire fog dominant. Hard-fern is re-establishing, and its spread back against such a turf will be sure and rapid.

[*Photos by E. Bruce Levy.*

being more restricted to the knolls and poorer slopes and aspects. With the drain of soil fertility that must follow years of grazing and removal of herbage there is bound to arrive a state that no longer meets the fertility requirement of brown-top and Lotus major. Then Danthonia pilosa will everywhere become dominant and the carrying-capacity will fall. By top-dressing, say, every third year with 3 cwt. of superphosphate or basic slag per acre on the average country a sward of brown-top and Lotus major, with some white clover, crested dogstail, and rye-grass, is assured, and such should be the aim; but as time goes on, without manuring the best that can be expected from the general slopes is a sward of Danthonia pilosa and suckling clover, with some stunted brown-top and weak Lotus major. The drier and poorer knolls on the experimental areas show this change at the present time, and it is for this reason that the inclusion of Danthonia pilosa in the original mixture sown is so very important. However, even where the soil-fertility has fallen and danthonia has become dominant, the Lotus major is still persisting and is materially helping the danthonia to ward off that dry bottom and dead leafage common in dominant danthonia when unassociated with any clover species.

Manurial trials have been conducted throughout the course of the experiments. Basic slag, superphosphate, basic super, Ephos phosphate, super and lime, super and Nauru ground rock phosphate, and Nauru alone have been tried. In certain cases these manures have been cross-treated with sulphate of ammonia and sulphate of potash. No exact measurement records were possible on the country treated, but, judging from eye-appearance, superphosphate alone appeared to give best results, and superphosphate in combination with lime and Nauru phosphate seemed to give at least results equal to basic slag. The response from sulphate of ammonia is marked for a short period only, and little response if any can be seen from potash dressings. It would appear that super alone or super and Nauru, taking into consideration the ease of handling and spreading this in comparison with basic slag, are the best manures. At present prices money spent for superphosphate would pay better than the same amount spent for any other class of fertilizer.

FENCING.

Control of stock is the first consideration in breaking in secondary-growth country. Many of our experimental sowings were made in 5-acre blocks within large paddocks, where control of stock was quite impossible. Certain of these have been burnt and sown, followed by manuring, until the secondary growth became so dense as to make further work appear foolish, as indeed it was. Obviously, unless stock are working on the area and can be controlled at will, the problem is almost hopeless. Sufficient subdivisional fencing to control stock is imperative.

THE SLASH-HOOK AND SPRAY-PUMP.

The firestick and cattle represent the cheapest implements for the destruction of existing secondary growth wherever these can be satisfactorily employed, but there are certain classes of secondary growth where these implements fail. Burning standing manuka that has set seed, unless a sufficiently hot fire is secured to consume all foliage and seed capsules, results in a fresh and thicker crop of manuka. A fire

skimming through manuka growth usually leaves the seed capsules on, and the heat of the fire acts as a ripening process. The capsules open shortly after the fire and the seed is broadcast into the ash, where good establishment and a fresh crop of manuka is assured. Tutu will not readily burn, and cattle cannot be employed to break it down owing to its poisonous nature. Scrubs like tauhinu, gorse, blackberry, barberry, &c., are also difficult to control by fire and stock alone. No stock will eat hard-fern, and fire alone only serves as a partial remedy. For the complete destruction of these growths the settler has to use additional means, consisting of the slash-hook, the grubber, and the spray-pump, or to pull by hand, as in the case of young manuka.

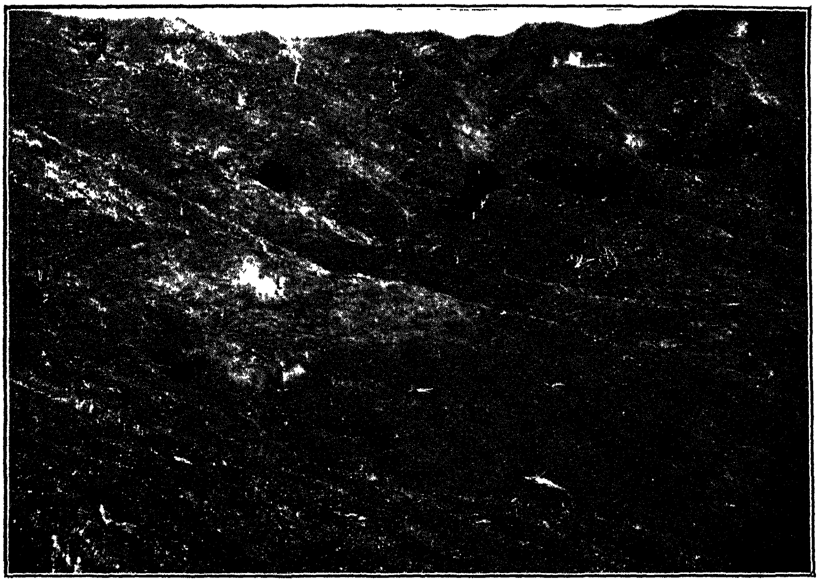

FIG. 12. APPLYING MANURIAL TOP-DRESSING TO PLOTS WITHIN AN EXPERIMENTAL AREA BURNT AND SOWN IN 1926.

Before clearing up, this entire slope was a mass of hard-fern and piripiri. Photo taken 1930. Of all manures tried superphosphate did the best on this area.

[*Photo by E. Bruce Levy.*

Spraying with arsenic pentoxide has been introduced to deal specifically with hard-fern in the course of these experiments, and particulars of the trials will be given in a later issue of the *Journal*. The use of goats to relieve the slash-hook and grubber in the case of shrubby growths such as tutu, gorse, and blackberry can be widely recommended as an aid to control.

(Series to be continued.)

Silage Losses.—It has been estimated that the loss in a well-built silage stack is 4 to 5 per cent., while in a badly built stack it may be 20 per cent. In the case of a well-constructed pit which has been well filled the loss need not exceed 1 per cent., whereas if the pit is badly filled the loss may range up to 10 per cent.

THE OVERRUN IN BUTTERMAKING.

G. M. VALENTINE, Palmerston North.

THE clause in the Dairy Industry Amendment Act, passed in 1922, requiring manufacturers of butter and cheese to furnish to every milk or cream supplier each year a statement showing the amount of butter and cheese made from each pound of fat received has led to an increased interest in the subject, and the question is frequently asked, What is the overrun? Overrun is usually spoken of as the amount of butter made in excess of the butterfat received. Owing to losses in manufacture, however, and to the allowance of overweight in each box of butter sold, in actual practice it is the amount of butter for which payment is received in excess of the butterfat paid for.

Overrun is made up of the water, salt, and curd which butter contains in addition to butterfat, which is the principal ingredient, but a true overrun does not include the whole of it. Overrun is usually shown as the percentage of butter in excess of the butterfat received, but may be shown as the weight of butter made from each pound of fat paid for. For example, if we pay for 100 lb. of fat and sell 120 lb. of butter the overrun is 20 per cent., and we have made 1·2 lb. of butter from every pound of fat paid for.

Overrun in buttermaking and yield in cheesemaking are the same, but in cheesemaking it is expressed as yield, as, for instance, pounds of cheese made per pounds of fat received = 2·6.

The percentage of overrun is calculated as follows: Butter made — fat received × 100 ÷ fat received = per cent. of overrun. For example: Butter sold, 240 lb.; butterfat paid for, 200 lb.; 240 — 200 = 40 lb.; overrun, 40 × 100 ÷ 200 = 20 per cent. overrun.

FACTORS INFLUENCING AMOUNT OF OVERRUN.

The factors which influence the amount of overrun are: (1) Errors in calculating the amount of fat received; (2) actual losses of fat in manufacturing; and (3) deficiency of matter not fat contained in the finished butter.

(1) ERRORS IN CALCULATING AMOUNT OF FAT RECEIVED.

Under the whole-milk system errors in calculating the amount of fat are not so likely to occur as when handling cream, since the former is weighed in larger quantities, is more liquid and therefore more easily sampled, and the testing is a simpler process. With cream, which is in smaller quantities and contains a higher content of butterfat, the same accuracy is not possible. The tare weights on cream-cans must be marked to half-pounds, and if not exact should be made so by the addition of solder to the bottom of the can. This can be done by the manufacturer, and the weight stamped on a brass plate in 1 in. letters and sweated on to the can. Net weight to ½ lb. must be credited to the supplier, and even then the fractional weights which cannot be credited will give the factory an advantage at this stage.

Sampling, on the other hand, and all other parts of the testing will incline to give the supplier the advantage, with the exception of fractions in reading the test, and the practice of some factories in crediting to $\frac{1}{2}$ per cent. is undoubtedly more accurate. Since these are matters of calculation, the term "loss" under this heading is hardly correct, as no butterfat is actually lost. Want of attention to these details, however, will have a considerable influence on the overrun, and consequently on the payments for butterfat. If all the fat received is paid for and 2 per cent. is allowed for losses in manufacture 100 lb. of fat will make 119·51 lb. of butter where cream is being received, if the butter made contains 82 per cent. of fat. $98 \times 100 \div 82 = 119{\cdot}51$ lb. butter: overrun, 19·51 per cent. A sample of cream which contains 40 per cent. of fat, if credited to the supplier as 38 per cent., will cause him a loss of 5 per cent. of his total butterfat. Thus on 40 the loss is 2; on 100 the loss is $2 \times 100 \div 40$ per cent. $= 5$, or for 100 lb. fat received only 95 lb. is paid for. The butter made is still 119·51 lb., and $119{\cdot}51 - 95 = 24{\cdot}51$ lb. butter made in excess of fat paid for. The overrun will therefore be $24{\cdot}51 \times 100 \div 95 = 25{\cdot}78$ per cent. The increase in overrun due to the lower reading of the cream test will be $25{\cdot}78 - 19{\cdot}51 = 6{\cdot}27$ per cent., or 3·135 per cent. for each 1 per cent. reduction in test. Similarly, the same error in a 30-per-cent. cream will result in a loss of 6·66 per cent. of fat to the supplier, and the overrun will be increased by 8·40 per cent., or 4·2 per cent. for each 1 per cent. reduction in test. Should the error result in an overcredit of 2 per cent. the overrun will be reduced by 5·84 per cent. when 40 per cent. of cream is being received, and by 7·68 per cent. with 30 per cent. of cream.

Gains.

Apart from actual errors in weighing, &c., there are, as already stated, certain factors which must be allowed for, and as the result of these the amount of fat actually received may be more or less than that paid for.

Tare weights of cream-cans must be marked at the nearest half-pound above the actual weight, and cream may be recorded at the half-pound below actual weight. In each case the law of average will ensure that the factory will gain half the highest possible fractional gain—that is, 3·5 oz. on tare weights and 3·5 oz. on cream, a total of approximately 7 oz. per weighing. The factory having a daily delivery, one which has a large number of small suppliers, or one which weighs all cans singly, will therefore gain more than one having an every-other-day delivery or one following the practice of weighing a number of cans at a time.

Theoretically the gain from this source will be: (Number of weighings $\times \frac{7}{16}$ lb.) $\times$ average test $\div 100 =$ pounds of fat gained. If the average weight of cream in each can is taken at 50 lb. the gain will be 0·875 per cent. ($\frac{7}{16} \times 100 \div 50 = 0{\cdot}875$ per cent.). In actual practice few factory scales are accurate enough at all points to give such a result, or to maintain such accuracy all day and over the whole year under the conditions obtaining in factory work.

Cream tests may be recorded to the nearest full point below actual, and the gain to the factory under this heading will therefore be 0·45

on each test. Taking the average test as 40 per cent. this will amount to 1·125 per cent. of the total fat received if the advantage is taken by the factory in every case. ($0·45 \times 100 \div 40 = 1·125$ per cent.).

Although the regulations under the Dairy Industry Act require that the cream weights shall be recorded at the half-pound below actual weight, and tests are generally recorded at the nearest full point below actual, there is nothing to prevent the dairy company recording at the nearest half-pound above actual or the nearest point above actual. This practice was the one commonly followed in the early days of home-separation, but the keen competition which obtains to-day has led to most factories adhering to the letter of the regulation, and figures available indicate that the gain in overrun from this source would be at least 1 per cent. if no losses were incurred to balance the gain.

A further small gain will be made by the factory from fractions which are not paid for when calculating the weight of butterfat.

Losses.

Under the heading of actual losses, dealt with later on, and for which 0·75 per cent. has been allowed, are certain items which are incurred on the receiving-platform. They include amount taken for testing, spillage, fat left in cans and on floats, &c.

The greatest inaccuracy, though not an actual loss, is due to faulty sampling, especially when dealing with cream which is not received daily; in a lesser degree evaporation from samples and testing-scales which are not sufficiently sensitive, all of which will cause a loss to the factory.

The influence of improper sampling will depend on the methods followed in the factory, and cannot be estimated. Sweet cream received daily will not be so difficult to sample correctly, as it can be more easily mixed, and it is then only a matter of getting a proportionate sample from each can.

Sour cream will require a good deal more stirring, the amount required depending on the care which the cream has received on the farm and the length of time it has been held. If it has been left without stirring over a long period it will be almost impossible to get a correct sample without heating, which is not practicable in everyday work. The result will be that the factory will pay for more fat than it receives.

Unless the sample is proportionate to the amount of cream which the can contains, the result may be either a loss or a gain. A large can of thin cream and a small can of rich cream from the same supplier will result in a loss to the factory if the same amount of sample is taken from each, while a gain will result if the large can contains rich cream and the small one thin cream.

A separator set to deliver 40 per cent. cream while 4 per cent. milk is passing through it will deliver approximately 36 per cent. cream when separating 3·6 per cent. milk. This is not an exceptional difference in test between evening and morning milk, and as the weight of evening milk under such conditions is generally considerably less than the morning milk there would be a corresponding difference in the weight of cream. Should the supplier send in each skimming in a separate

can, and an equal quantity be taken from each, his test would be higher than it should be, thus causing a loss to the factory.

In short, all conditions which influence the test of the milk will also influence the test of the cream, and, in addition, there will be the further influences such as temperature, speed of separator, &c., all of which point to the necessity for taking a sample proportionate to the weight of cream in each can received during the whole period. Where daily testing is carried out, the necessity for a proportionate sample as between one delivery and the next will, of course, be done away with.

As a theoretical example the following will illustrate the necessity for proportionate sampling :—

	lb.		Per Cent.			lb. Fat.
One can containing	97	of	36	cream	contains	34·92
One can containing	30	of	40	cream	contains	12·00
Total	127					46·92

The correct test of the two cans would be $46{\cdot}92 \times 100 \div 127 =$ 37 per cent. One dipper from each would give a test of $36 + 40 \div 2 =$ 38 per cent., and a butterfat content of $127 \times 38 \div 100 = 48{\cdot}26$ lb. fat, an excess of 1·34 lb., or 2·85 per cent. of fat. If all the fat received were paid for in like manner the overrun would be reduced by approximately 3·4 per cent.

If, on the other hand, the larger can tested 40 per cent. and the smaller one 36 per cent., the factory would gain 1·34 lb. of butterfat, or 2·7 per cent., with a rise of approximately 3·24 per cent. in overrun.

This assumes that the cans were thoroughly stirred, and that the individual tests were correct. Just what would happen if this were not done can be only a matter of conjecture, but the common experience of butter factories is that the overrun drops sharply in the winter, indicating the difficulty of getting a correct sample of thick viscous cream.

A change in the man doing the sampling has been known to cause a drop of 5 per cent. in the overrun at a factory, and the same difference has been known to be due to evaporation from the sample bottles.

Although the foregoing remarks have dealt with cream, the effect is the same in a lesser degree where milk is handled. The fractional margins in weighing will be very small, but, in testing, the position will be practically the same, while sampling will be a much simpler matter on account of the fluid nature of the milk.

With a view to obviating these discrepancies in cream-testing the simple methods of testing by composite sample and payment on butterfat have been varied in other dairying countries, and more complicated procedure is required, such as (1) Weighing and testing of individual cans of cream belonging to one supplier, unless the whole of the cream is emptied into one receptacle ; (2) daily testing of all cream received, daily calculation of the fat content, and in some cases a daily estimation of the weight of butter it will produce ; (3) payment on the manufactured article, either butter or cheese ; (4) adjustment of the overrun to a standard by all factories. All of these have for their object the prevention of errors in testing, and the elimination of the advantage gained by the factory as a result of these errors when payment is made on butterfat.

(2) ACTUAL LOSSES OF FAT.

Two systems of butter-manufacture are in operation under factory conditions—namely, (1) butter made from whole milk received, and (2) butter made from cream received ; these two systems are generally spoken of as "whole milk" and "home separation." A few factory concerns operate both systems.

The actual loss of fat under the whole-milk system averages probably 4 per cent. of the fat received in the milk, and under the home-separation system 2 per cent. of the fat received in the cream. Under the whole-milk system the actual losses of fat may be classified under four heads: (1) Loss in skimming milk, (2) loss in handling cream and butter; (3) loss in buttermilk; and (4) loss in packing butter. In the home-separation system the actual losses come under the last three heads.

The percentage of fat lost in skim-milk and in buttermilk can be ascertained by means of the butyl alcohol Babcock test. This test gives results corresponding closely to results obtained by gravimetric analysis, and shows higher and more correct results than are readable in the ordinary Babcock test. The test is, briefly, 2 c.c. of normal butyl alcohol, 9 c.c. of milk, and 7 to 9 c.c. of 1·82–1·83 specific gravity sulphuric acid, placed in a 0·5 graduated bottle, whirled 6–2–2 minutes, and the reading doubled.

Skim-milk is generally about 85 per cent. to 90 per cent. of the whole milk, and contains nominally about 0·09 per cent. of fat. This loss varies, and losses as high as 0·1 to 1·13 per cent. have been reported. When milk containing 4 per cent. of fat is separated the loss of fat from that received in the milk is approximately 2·0 per cent. Thus 90 lb. of skim-milk contains $0·09 \times 90 \div 100 = 0·081$ lb. fat. From 4 lb. fat in milk the loss is 0·081 lb. From 100 lb. fat in milk the loss is $0·081 \div 4 \times 100 = 2·025$ per cent. The loss of fat in handling cream from the separator to the pasteurizer, in running it to the churn, and in the handling of the resultant butter (exclusive of the loss in buttermilk), and in packing or pounding the butter, is difficult to estimate, but can reasonably be set down at 0·75 per cent. of the fat received.

The amount of buttermilk from cream containing 40 per cent. of fat, including an allowance for water used in handling and churning, may be stated at about 65 lb. per 100 lb. and a normal percentage of fat in the resultant buttermilk is about 0·65, though as a result of the use of the butyl alcohol test it has been ascertained that the test of buttermilk from different churnings may range to as high as 1·5 per cent. A test of 0·65 per cent. is equal to a loss of 0·978 per cent. of the total fat received. Allowing 12 per cent. of the weight of fat as the weight of serum retained in the churned butter, we have $(65 - 4·8) \times 0·65 \div 40 = 0·978$ per cent., or 1 per cent. in round figures.

Boxes of bulk butter usually contain 56 lb. 6 oz., including the weight of the wrapping-paper, which, when taken off, weighs about 4 oz. It is customary to place 2 oz. of butter in each box and make no charge for it, to allow for possible shrinkage and other wastage. A similar allowance is sometimes made for unavoidable losses incurred in

pounding up each 56 lb. of butter for local trade. With butter containing 82 per cent. of fat the loss is 0·222 per cent. of the fat contained in the butter.

It is recognized that some of the losses have in practice occurred before that stage of manufacture has arrived for which later losses have been calculated. The variations thus caused are, however, of no practical significance for our purposes, as they affect only the second place of decimals.

In each system the actual losses of the fat received are therefore approximately as follows :—

Under Whole Milk.	Per Cent.
Skim-milk	2·0
Handling cream and butter ..	0·75
Buttermilk	1·00
Packing butter	0·222
Total	3·972

Under Home Separation.	Per Cent.
Handling cream and butter ..	0·75
Buttermilk	1·00
Packing butter	0·222
Total	1·972

The constituents of butter are generally noted in short analyses under four heads as (1) fat, (2) water, (3) salt, (4) curd and ash. The average fat content of New Zealand butter is about 82·5 per cent., but under exceptional circumstances it may be as low as 82 per cent., plus 15·5 per cent. of water, 1·75 per cent. of salt, and 0·75 per cent. of curd and ash. There are few factories which maintain this composition from day to day, however, and it must be regarded as a possible but not probable performance.

The overrun under the whole-milk system when butter of such composition is made, and the loss of fat is 4 per cent. of the fat received in the milk, will be 17·07 per cent. Thus, $100 - 4 = 96$ lb. fat sold in butter; $96 \times 100 \div 82 = 117{\cdot}07$ lb. butter made per 100 lb. fat purchased in milk, giving an overrun of 17·07 per cent.

Under the home-separation system, and when the loss of fat is 2 per cent. of the fat received in the cream, the overrun will be 19·51 per cent., as shown on page 94.

If it were possible to manufacture fat into butter without loss, and to maintain the legal minimum of 80 per cent. of fat in the butter, it would be possible to make an overrun of 25 per cent. Since 80 lb. fat—the legal minimum percentage—would make 100 lb. butter, 100 lb. fat would make 125 lb. butter, or an overrun of 25 per cent. But as manufacturing losses do occur, if we assume these to be as indicated above, the overrun will be as follows :—

Under whole milk 100 lb. fat received, less 4 lb. lost, equals 96 lb. fat retained in butter sold. If 80 lb. of fat makes 100 lb. of butter, 96 lb. fat would make $96 \times 100 \div 80 = 120$ lb. butter, or an overrun of 20 per cent.

Under home separation 100 lb. fat received, less 2 lb. lost, equals 98 lb. fat retained in the butter sold. If 80 lb. fat makes 100 lb. butter, 98 lb. fat would make $98 \times 100 \div 80 = 122{\cdot}5$ lb. butter, or an overrun of 22·50 per cent. As the fat content of butter is sometimes as high as 85 per cent., however, and as 80 per cent. is seldom found, a fat content of 82 per cent. may be taken as being below the average.

At first sight the foregoing figures would seem to indicate that the home-separator factory is the most profitable to supply. The whole-milk factory pays for all the butterfat which the milk contains, while the home-separator factory pays for all the butterfat contained in the cream which it receives. Each 100 lb. of fat delivered in the cream represents at least 102 lb. produced on the farm when allowance is made for losses in skimming.

The whole-milk factory makes 117·07 lb. of butter from each 100 lb. of fat paid for, and, if it receives 1s. per pound of butter net, can pay out 117·07s. ÷ 100 = 14·0484d. per pound butterfat. The home-separator factory makes 119·51 lb. butter from each 100 lb. fat paid for and can pay 119·51s. ÷ 100 = 14·3412d. per pound of butterfat. But if the supplier allows for losses in skimming he receives only 119·51s. ÷ 102 = 14·06d. per pound of fat produced, so that the advantage is more apparent than real.

(3) DEFICIENCY OF MATTER NOT FAT.

The amount of matter not fat which butter may contain is limited by legal enactment, which requires that butter shall contain not less than 80 per cent. of milk fat (butterfat) and not more than 16 per cent. of water. These two requirements conform to those current in the markets to which New Zealand butter is shipped. In most of the markets in Great Britain a salt content exceeding 2 per cent. is objected to, and to meet this position a further regulation limits the amount of salt to that figure. Complaints of oversalting have been received regarding butter which contained less than 2 per cent., and 1·5 per cent. has at times been found to be excessive when making butter from ripened cream. Allowing a maximum of 16 per cent. of water and 2 per cent. of salt, plus 1 per cent. of curd—a total of 19 per cent. of matter not fat—it will be seen that the minimum of fat possible will be 81 per cent., except under exceptional circumstances such as when making for the American market, which requires from 3 to 3·5 per cent. of salt. In such circumstances the fat content of the butter will be reduced and the overrun increased. When making unsalted butter the result will be the opposite—the fat content of the butter will increase and the overrun will be reduced.

When making for the British market, it can be regarded as exceptionally good work if butter is made which averages: fat, 81·5 per cent.; water, 15·7 per cent.; salt, 1·8 per cent.; and curd, 1 per cent. The overrun if this average is maintained would therefore be—whole milk, 17·79 per cent.; home separation, 20·25 per cent. if all the fat received is paid for.

A careful check can be kept on the various constituents of the butter made, by means of the several tests with which all buttermakers are familiar, provided a representative sample of the butter in the churn is obtained. To do so it is necessary to take small pieces of butter from different parts of the churn and emulsify and thoroughly mix them. Tests may be made from the same sample in the following order: Moisture, by the drying-off method; fat, by the benzine process; salt, by the silver nitrate test; and curd and ash, by subtracting the total of the first three from one hundred.

The accompanying table shows the overrun obtainable under varying conditions, and gives an indication whether the losses under either

Table 1.—Overrun obtainable under Varying Conditions.

Composition of Butter.		Percentage of Manufacturing Losses.																
Fat Per Cent.	Matter not Fat Per Cent.	0	0·25	0·50	0·75	1·0	1·25	1·5	1·75	2·0	2·25	2·5	2·75	3·0	3·25	3·5	3·75	4·0
		Percentage of Overrun.																
80·00	20·00	25·00	24·68	24·37	24·06	23·75	23·43	23·12	22·81	22 50	22·18	21·87	21·56	21·25	20·93	20·62	20·31	20·00
80·25	19·75	24·61	24·29	23·98	23·67	23·36	23·05	22·74	22·42	22·11	21·80	21·49	21·18	20·87	20 56	20·24	19·93	19·62
80·50	19·50	24·22	23·91	23·60	23·29	22·98	22·67	22·36	22 04	21·73	21·42	21·11	20·80	20·49	20·18	19·87	19·56	19·25
80·75	19·25	23·83	23·52	23·21	22·91	22·60	22·29	21·98	21·67	21·36	21·05	20·74	20·43	20·12	19·81	19·50	19·19	18·88
81·00	19·00	23·45	23·14	22·83	22·53	22·22	21·91	21·60	21·29	20·98	20·67	20·37	20·06	19·75	19·44	19·13	18·82	18·51
81·25	18·75	23·07	22·76	22·46	22·15	21·84	21·53	21·23	20 92	20·61	20·30	20·00	19·69	19·38	19·07	18·76	18·46	18·15
81·50	18·50	22·69	22·39	22·08	21·77	21·47	21·16	20·85	20·55	20·24	19·93	19·63	19·32	19·01	18·71	18·40	18·09	17·79
81·75	18·25	22·32	22·01	21·71	21·40	21·10	20·78	20·48	20·18	19·87	19·57	19·26	18·96	18·65	18·34	18·04	17·73	17·43
82·00	18·00	21·95	21·64	21·34	21·03	20·73	20·42	20·12	19·81	19·51	19·20	18 90	18·59	18·29	17 98	17·68	17·37	17·07
82·25	17·75	21·58	21·27	20·97	20·66	20·36	20·06	19·75	19·45	19·14	18·84	18·54	18·23	17·93	17·62	17·32	17·02	16·71
82·50	17·50	21·21	20·90	20·60	20·30	20·00	19·69	19·39	19·09	18·78	18·48	18·18	17·87	17·57	17·27	16·96	16·66	16·36
82·75	17·25	20·84	20·54	20·24	19·93	19·63	19·33	19·03	18·73	18·42	18·12	17·82	17·52	17·22	16·91	16·61	16·31	16·01
83·00	17·00	20·48	20·18	19·67	19·57	19·27	18·97	18·67	18 37	18·07	17·77	17·46	17·16	16·86	16·56	16·26	15·96	15·66
83·25	16·75	20·12	19·8	19·51	19·21	18·91	18·61	18·31	18·01	17·71	17·41	17·11	16·81	16·51	16·21	15·91	15·61	15·31
83·50	16·50	19·76	19·46	19·16	18·86	18·56	18·26	17·96	17·66	17·36	17·06	16·76	16·46	16·16	15·86	15·56	15·26	14·96
83·75	16·25	19·40	19·10	18·80	18·50	18·20	17·91	17·61	17·31	17·01	16·71	16·41	16·11	15·82	15·52	15·22	14·92	14·62
84·00	16·00	19·04	18·75	18·45	18·15	17·85	17·55	17·26	16·96	16·66	16·36	16·07	15·77	15·47	15·17	14·88	14·58	14·28
84·25	15·75	18·69	18·39	18·10	17·80	17·50	17·20	16·91	16·61	16·31	16·02	15·72	15·43	15·13	14 83	14·54	14·24	13·94
84·50	15·50	18·34	18·04	17·75	17·45	17·15	16·86	16 56	16·27	15 97	15·68	15·38	15·08	14·79	14·49	14·20	13·90	13·60
84·75	15·25	17·99	17·69	17·40	17·10	16·81	16·51	16·22	15·92	15·63	15·33	15·04	14·74	14·45	14·15	13 86	13·56	13·26
85·00	15·00	17·64	17·35	17·05	16·76	16·47	16·17	15·88	15·58	15·29	15·00	14·70	14·41	14·11	13 82	13·52	13·23	12·94

of these headings have been excessive, providing all and only the butterfat received has been paid for. It will be noted that when the butter made contains 82 per cent. of fat, the loss of each 1 per cent. of fat in manufacturing reduces the overrun approximately 1·22 per cent. The loss of 1 per cent. in matter not fat, such as a low water content, reduces the overrun 1·48 per cent. approximately. The aim of the buttermaker will be, then, to retain as much water in the finished butter as the legal standard will allow, and the maximum amount of salt, having due regard to the taste of the buyer, since any deficiency in either must be made up with butterfat and the overrun be thereby reduced. In the first case there is an actual loss of 1 lb. of fat in every 100, plus the matter not fat which could have been added to it. In the second there is no actual loss of fat, but 1 lb. has been added to every 82 lb. to replace a deficiency of salt or water and the loss is 1 lb. of fat in every 83 lb. used, plus the difference between 17 and 18 per cent. of matter not fat, which is added to each pound of fat contained in the butter. Hence a composition loss is a greater one than a manufacturing loss.

TRUE OVERRUN.

Accepting 82 per cent. in the butter as better than average work, and losses in manufacture as 4 per cent. under whole milk and 2 per cent. under home separation, it follows that any overrun in excess of 17·07 per cent. and 19·51 per cent. must be obtained as the result of receiving fat which was not paid for. In the case of milk each 1 per cent. of fat so gained will make a difference of about 1·2 per cent. in overrun, and with cream a difference of about 1·22 per cent. The amount will vary with the test of the milk being skimmed and the test of the cream churned, a low test in both cases resulting in a higher percentage loss of fat.

As stated on page 93, a true overrun does not include the whole of the matter not fat contained in the butter. Thus if 98 lb. of fat makes 119·51 lb. of butter there must be 21·51 lb. of water, &c. But the overrun is only 19·51 per cent., as the manufacturing losses—2 per cent.—have to be taken from it and added to 98 to make it up to 100 on which the overrun is calculated.

An overrun which was the same percentage as the weight of water, &c., contained in the weight of butter made per 100 lb. of fat paid for would indicate that butterfat equal to the manufacturing losses had been received but not paid for. If it exceeded that amount the gain so made must have been that much greater, as the following table will show:—

Table 2.

Butter made.	Fat in Butter.	Water Salt Curd.	Fat paid for.	Amount of Overrun.	Percentage of Overrun.
Lb.	Lb.	Lb.	Lb.	Lb.	
119·51	98	21·51	100	19·51	19·51
119·51	98	21·51	98	21·51	21·95
119·51	98	21·51	96	23·51	24·48

In the first case the weight of overrun is reduced by the pounds of fat lost in manufacture, and the percentage of overrun is reduced by that amount. In the second the weight of overrun is the same as the weight of water, &c., and the percentage of overrun exceeds it, indicating that the loss in manufacture was recovered from fat received but not paid for. In the third the weight of overrun exceeds the weight of water, &c., indicating that the loss in manufacture, plus a further 2 lb., was recovered from fat received but not paid for.

Thus a true overrun does not include the whole of the water, &c., contained in the butter, while a false overrun contains some fat which has not been paid for.

Influence of the Overrun on Payments for Fat.

The influences of the overrun on the payment for fat may be seen in this way: If we have 100 lb. of fat and make 120 lb. of butter worth 1s. per pound, 1 lb. of fat is worth 120s. ÷ 100 = 14·4d. But if only 115 lb. of butter is made from 100 lb. of fat, 1 lb. of fat is worth only 115s. ÷ 100 = 13·8d.: or 1s. × 1·15 = 13·8d. The value of the overrun per pound of fat is therefore in the first case 14·4d. − 12d. = 2·4d., and in the second 13·8d. − 12 = 1·8d.

If the expense of making and marketing amounts to 1·8d. per pound of fat the factory will be able to pay out 1s., the same price as received for butter when the overrun is 15 per cent., but if the expenses exceed 1·8d. the payment for butterfat will be less per pound than was received for butter; but with a 20-per-cent. overrun and the same manufacturing costs the factory can pay 14·4d. − 1·8d. = 12·6d. per pound, or 0·6d. more than was received per pound for butter. Assuming that each supplier has been credited with his correct amount of fat, and that the reduced overrun is the result of faulty manufacturing methods, the loss falls equally on all suppliers. But should the low overrun be the result of error in weighing, testing, &c., it is only one of calculation, and will fall unfairly on certain suppliers.

Taking three suppliers sending in 30, 40, and 50 per cent. cream, and assuming that they are credited with 31, 41, and 51 tests: the first will be paid for 3·33 per cent. too much fat; the second will be paid 2½ per cent. too much; and the third will be paid for 2 per cent. too much. Since the percentage of error is not evenly distributed, and there is only a certain sum available for distribution, the first will receive more money than he is entitled to, the second will receive about the correct amount, and the third less than he is entitled to, in spite of the fact that one point has been added to his test. Should the error result in a similar reduction in test the first will receive less than his due, the second will receive about the same as before, and the third more money than he is entitled to, although his test has been read down a point.

Assuming that each of these suppliers delivered 1,000 lb. of cream during the period, that the overrun obtained by the factory was 20 per cent., and that the value of the butter was 1s. per pound after all expenses were paid,—

(*a*) Pounds of fat actually delivered 300 + 400 + 500 = 1,200 lb.
Butter made with a 20-per-cent. overrun, 1,440 lb.
Amount available for distribution, 1,440 lb. at 1s., 1,440s.
The price paid per pound of fat would be 1,440s. ÷ 1,200 = 14·4d.

(*b*) If the tests were overread 1 per cent. the fat paid for would be 310 + 410 + 510 = 1,230 lb.

The butter made would still be 1,440 lb., worth 1,440s.

The overrun would be 1,440 — 1,230 = 210 × 100 ÷ 1,230 = 17·07 per cent.

The price paid per pound of fat would be 1,440 ÷ 1,230 = 14·048d.

(*c*) If the tests were underread 1 per cent. the fat paid for would be 290 + 390 + 490 = 1,170 lb.

The butter made would still be 1,440 lb., worth 1,440s.

The overrun would be 1,440 — 1,170 = 270 × 100 ÷ 1,170 = 23·07 per cent.

The price paid per pound of butterfat would be 1,440s. ÷ 1,170 = 14·769d.

Collectively the three suppliers would receive the same under all conditions—

1,200 lb. of fat at 14·4d. = 1,440s. distributed.
1,230 lb. of fat at 14·048d. = 1,440s. distributed.
1,170 lb. of fat at 14·769d. = 1,440s. distributed.

Individually they would receive more or less than they were entitled to according to the testing of the cream. The actual amount which each should receive would be—

	s.
(1) 300 lb. fat at 14·4d. =	360
(2) 400 lb. fat at 14·4d. =	480
(3) 500 lb. fat at 14·4d. =	600
Total	1,440

If the tests are overread 1 per cent.,—

(1) 310 lb. of fat at 14·048d. = 362·906s.; gain, 2·906s.
(2) 410 lb. of fat at 14·048d. = 479·973s.; loss, 0·027s.
(3) 510 lb. of fat at 14·048d. = 597·04s.; loss, 2·96s.

Total—

1,230 lb. of fat at 14·048d. = 1,439·819s.

If the tests are underread 1 per cent.,—

(1) 290 lb. of fat at 14·769d. = 356·917s.; loss, 3·083s.
(2) 390 lb. of fat at 14·769d. = 479·972s.; loss, 0·028s.
(3) 490 lb. of fat at 14·769d. = 603·076s.; gain, 3·076s.

Total—

1,170 lb. of fat at 14·769d. = 1,439·976s.

So far as the dairy company is concerned it is in the same position whether it pays for 1,230 lb. fat at 14·048d. per pound or 1,170 lb. of fat at 14·769d. per pound, but the effect on the amount which the supplier will receive will depend on his test. The nearer the test is to the factory average the less will it be affected by inaccuracies in testing.

As stated on page 94 there are two methods of payment other than butterfat which have been adopted in dairying countries in order to minimize the advantage gained by the factory in the rate of payment per pound as the result of receiving fat which is not paid for. These are payments on the finished butter and standardization of the overrun.

Taking A, B, and C as three factories, the effect of the first method would be as follows :—

(A) The factory having credited all the fat received and made a normal overrun would obviously pay out 1s. per pound, the net price received, on a butter basis. This figure can also be calculated as follows : Price paid per pound fat ÷ yield per pound fat = price paid per pound of butter. 14·4d. ÷ 1·20 = 12d. per pound of butter.

(B) Price paid per pound of fat 14·048d. ÷ 1·1707 = 12d. per pound of butter.

(C) Price paid per pound of fat 14·769d. ÷ 1·2307 = 12d. per pound of butter.

An error in the calculation of the amount of butterfat does not affect the amount of butter made in any way, and consequently the price paid on a butter basis can be influenced by the price received and the cost of manufacture only. An actual increase in the amount of butter made from a given quantity of fat will increase the number of pounds of butter to be paid for, but not the rate per pound. Conversely, a reduction in the amount made will decrease the number of pounds paid for, but not the rate per pound.

The system, therefore, has the advantage that the rate paid per pound is not inflated as the result of receiving fat which is not paid for. It does not give credit to the factory actually making more butter than its competitors from a given amount of butterfat. It does not prevent inferior work being covered up by reading down tests in order to make up for composition and manufacturing losses, and thus give an overrun which is normal. The total sum received by each supplier would not be affected, since the amount paid for would be based on the fat credited plus the percentage of overrun.

Under the standardized overrun method the position would be as follows if the standard were fixed at 20 per cent. :—

A, having a standard overrun, would have no adjustment to make and would pay 14·4d. per pound of fat.

B, having made such a small amount of butter from the weight of fat paid for, would require to look into his methods of testing and manufacture and eliminate the cause, since he could not be allowed to make an adjustment at the expense of the supplier.

C, having paid for less fat than was received, would have to increase the amount credited to each supplier as follows :—

$$\frac{1{\cdot}2307 \times 100}{1{\cdot}20} = 102{\cdot}5 \text{ lb. fat received for each 100 lb. paid for.}$$

$$\frac{1{,}170 \times 102{\cdot}5}{100} = 1{,}199{\cdot}25 + (1{,}200) \text{ lb. of fat actually received.}$$

$$\text{Overrun} = \frac{(1{,}440 - 1{,}200)\ 100}{1{,}200} = 20 \text{ per cent.}$$

Price paid : 1,440s. ÷ 1,200 = 14·4d. per pound of fat.

Similarly to the payment on butter, the total sum paid to each supplier is not altered, as any error in the method of determining his fat is not corrected. From the New Zealand point of view this has the advantage that it retains the fat basis of payment. It has the merit of discouraging any attempt to get an overrun in excess of the

figure set, at the expense of the supplier, but might be an inducement to factories to reach the standard at any cost. No method has yet been devised, however, which will rectify the unfairness to the supplier which is the result of incompetent or dishonest work in the factory.

CONCLUSION.

From the foregoing it will be seen that the overrun plays a very important part in the affairs of a dairy factory, and the necessity for checking it at each testing-period cannot be too strongly emphasized. The greatest care is required from the time the milk or cream is received until the butter is packed, and each step of the process must be carefully checked in order to avoid unnecessary losses.

Putting aside the accurate testing of milk and cream, which have been fully dealt with on many occasions, practical and reliable tests are available with which all buttermakers are familiar. Of these the moisture and salt tests are the most important, as these two ingredients practically determine the fat content of the butter and to a great extent the overrun. Manufacturing losses cannot be reduced below a certain minimum, as a percentage of loss is unavoidable, while the curd content of butter cannot be increased without endangering the keeping-qualities of the butter. The factors of moisture and salt, however, are, within certain limits, in the hands of the buttermaker.

The belief seems to prevail among factory-suppliers that the buttermaker making a high overrun has some knowledge which is not possessed by his more moderate competitor. There are only two means whereby an overrun can be increased without loss to the supplier—namely, reduction in the fat content of the finished butter, and reduction in the manufacturing losses. The possible saving in each case would not exceed ½ per cent. when comparing the work done by two well-managed factories, and the first will give an increase of approximately 0·74 per cent. in overrun, while the second will give approximately 0·61 per cent. increase, a total of 1·35 per cent. Accepting 19·51 per cent. as a normal overrun when all fat is paid for, the maximum would therefore be 20·86 per cent. under the home-separation system, and any further increase must be due to the receipt of fat not paid for.

Rimu Poles for Telegraph and Power Lines.—The annual report of the State Forest Service for 1930–31 refers to developments in this direction as follows: "In an effort to meet a greater portion of the local demand for telegraph and power poles, most of which are at present imported, strength and preservation tests of full-sized rimu poles were carried out with considerable success. The coastal type of rimu forest in Westland and Southland yields poles of excellent shape and strength, and with the development of suitable treating methods, which is contingent upon the establishment of an experimental pressure treating plant, it is anticipated that a thriving industry may soon be established. Approximately 100 poles treated by the non-pressure process have now been placed in use, and will be carefully inspected at regular intervals along with the numerous treated fence-post lines installed in previous years. These service test lines have now definitely established the fact that in most localities a butt treatment is insufficient, and that posts, poles, &c., must receive a fairly heavy full-length preservative treatment to give a satisfactory life."

ELIMINATION OF SMUT DISEASES FROM THE MALTING-BARLEY CROPS OF ELLESMERE DISTRICT.

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THE Ellesmere district of Canterbury produces about one-half of the total New Zealand output of malting-barley—some 5,000 to 6,000 acres being grown annually in crops of an average size of about 25 acres. Until the year 1925 loose smut, covered smut, and stripe disease were present to a greater or lesser extent in every crop, covered smut in particular being very prevalent and the cause of severe losses.

In that year the Canterbury (N.Z.) Seed Co., Ltd., who are the principal buyers of barlev in the district, installed a plant for the treatment of cereal seed by a modification of the Jensen hot-water method. In each succeeding year selected lines of barley have been treated and grown—chiefly on the company's own farms—to provide sufficient seed to supply the wants of their contract growers. All these crops "direct from treatment" have remained free from smut, and practically free from stripe.

The product — "once-removed from treatment seed" — has also produced smut-free crops, since from the beginning great care has been taken to prevent recontamination in handling. This seed, producing as it did crops high in yield and in quality of grain, free from smut, soon came into general favour in the district, so that by 1929 practically all barley sown was once or twice removed from the hot-water treatment.*

Each year since 1925 disease surveys of the district have shown a steady decrease in the incidence of these seed-borne diseases. Loose smut, infection with which can take place only in the growing crop, was soon eliminated—none having been detected since the 1928–29 season. Covered smut, infection with which is largely due to spores adhering to the grain, and which consequently can be conveyed to clean seed by contaminated threshing and cleaning machines, took longer—a trace being detected in two crops in 1930–31, but none in the 1931–32 season. Stripe disease, though greatly reduced, was still present as a trace only in 21 per cent. of the crops in 1931–32.

No contracts for barley have been let during the present season, and in consequence a large proportion of the growers have used their own seed. Much of this seed has been through the common travelling threshing-mills, with no special precautions to avoid reinfection, so that the entire freedom of all crops from both smuts indicates that these diseases have been eliminated from the district. This result, which has been accompanied by a large increase in acre-yield and in quality of grain, has demonstrated the possibility — and the advantages—of this method for the control of seed-borne crop diseases.

In essence the method consists in the gradual replacement of infected seed within a definite area by the distribution of constantly renewed

* Hewlett, C. H., *N.Z. Jour. of Agric.*, Vol. 40, p. 104, 1930.

supplies of disease-free seed selected and bred under skilled supervision. Its success in the present case has been achieved by close co-operation between the Plant Research Station and the Canterbury Seed Co.

"BUSH SICKNESS" AND "DOPINESS": SOME COMPARISONS.

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As a considerable amount of confusion exists in the minds of many of those interested in the difficulties of "bush sickness" and "dopiness" attending sheep-farming in certain North Island districts, it is desirable that the points of difference which lead a chemist to suspect distinctness in these troubles should be enumerated. Both are what are called "deficiency diseases"—that is, they are due to something deficient in the diet. The proof of this is that veterinary pathologists fail to find any transmissible disease or parasitic infestation sufficient to account for the heavy mortality, that suitable food and water are present in sufficient amounts, and that the animals recover if removed to what is known locally to be healthy country, although this may be quite near that upon which they became sick.

Bush sickness is a wasting disease of the deficiency type characterized by emaciation and bloodlessness (anæmia) of the animal. The intensity of the disease is related to the coarseness of the soil. The coarser soil is found where animals are worst affected, the disease appearing in its mildest form on the finest of these affected soils. Typical bush sickness has so far not been found on any but very coarse-textured soil, which is technically* known under the terms "sandy silt," "coarse sand," or "fine gravelly sand." This is so not only with the disease in New Zealand, but also where a similar or the same disease occurs in Tasmania, South Australia, Kenya, the Cheviot Hills in Scotland, and Florida. Dune sands in various New Zealand localities when fixed and grassed are also believed to give rise to something similar to bush sickness in sheep.

In typical bush sickness as it occurs on coarse pumice soils ruminants never show any deterioration of the bones, which are always exceptionally well formed, indicating that an adequate supply of lime and phosphate has been obtained from the pasture. It has always been thought that bush sickness was restricted to ruminants (sheep, cattle, goats, deer), and that horses and all other herbivorous animals were immune although eating the same pasture that was available for the ruminants which became bush-sick. There are signs, however, that this conception will have to be revised. In Florida it is asserted that pigs suffer from anæmia when grazed on pasture on which cattle suffer from a deficiency disease officially said to be the same as the New Zealand bush sickness. Goats and sheep also suffer on this Florida soil. Again, at Mamaku and Kaharoa rabbits, although occurring sparsely, do not increase normally on these types, and appear to be migrants from healthy country.

* "Technically" refers to the special use of those terms in soil science. For instance, "the clay of the soil chemist is not the clay of the geologist" (Robinson).

Bush-sickness soils rapidly improve under occupation and utilization, the incidence of the disease being at its worst after the forest is burnt. Thereafter with grassing, stocking, and ultimately logging, ploughing, cultivating, cropping, resowing, and top-dressing, gradually the disease diminishes. Clovers are always evident in bush-sick pastures, and sometimes very abundant after top-dressing with phosphates.

Dopiness occurs in sheep, only on soils which are derived from volcanic dust or mud showers. These soils are not coarse-textured, but belong to that great class technically called "loams," on which most of the agriculture of the world is conducted. Clovers are deficient in these pastures, and the bones of affected animals are very light in weight. Chemical tests of the soils indicate a great deficiency of lime. Theoretically about 10 tons of carbonate of lime per acre would be required to satisfy the full absorption capacity. Leaching of the soils by rain has been strongly stressed by geologists as the cause of the deficiency disease, and this would accord with great lime deficiency, since phosphates are not leached from soils in appreciable amounts. The tendency for phosphates is to rise in the soil by the action of life and to become concentrated in the upper layers where leaves and bark of trees and the remains of animals decay, having obtained the phosphate they require from beneath the surface.

Soils on which dopiness occurs may be rightly called "deteriorated soils," at one time having been highly productive—that is, they are at their best immediately after a bush burn. The burning of the forest supplies anything up to ½ ton of ashes per acre; these consist mostly of carbonate of lime, which is gradually converted into bicarbonate, leached out, and lost. The pasture growing on these ashes is at its highest productive capacity within a couple of years after the burn. After this it slowly deteriorates, the sward changing gradually from rye-grass and white clover until finally only grasses such as Chewings fescue, danthonia, and brown-top remain.

Field experimentation in connection with both these diseases is greatly handicapped from the fact that abnormal seasons affect the incidence of the disease. In some years the mortality will be exceptionally high, in other years extremely low, so that the positive results which may be expected in normal years are obliterated by the general high or low mortality due to an unknown cause. Especially is this so in regard to sheep, which are injuriously affected by an abnormal rate of growth in the pasture difficult to control, probably due to exceptional seasonal effects, and which decidedly acts as an interfering factor in any experiments made with sheep. Extreme care is therefore required in the management of the pasture so as to keep it in a condition suitable for sheep.

Another marked difference in the response of the two types of soil suffering respectively from bush sickness and dopiness is in the way they respond to calcium applications. This element undoubtedly has very great influence for good on the dopiness soil when used either as lime itself or as salts of lime, with calcium phosphates (superphosphate, &c.), and calcium sulphate. It is impossible to grow cruciferous crops such as turnips, cabbages, rape, &c., without lime carbonate, and if attempted club-root affects them. Pasture is considerably improved by

lime and especially by superphosphate, which contains more than half its weight of calcium. It is considered that a mixture of lime and calcium phosphate when applied as a top-dressing is the remedy for dopiness. The use of licks containing calcium salts and bonedust has not yet had a fair trial. In the case of bush-sick coarse pumice soils lime at first has a deleterious effect on the stock pastured on lands recently limed, and in pot experiments lime shows a depressing effect on plant-growth. In field trials there is no appreciable response from the pasture. Club-root and other troubles curable by lime are not generally present on pumice lands, although turnips are benefited, as one would expect, by the addition of lime to the manure sown with the seed. The best fertilizer of all for both turnips and pasture is a mixture of basic slag and superphosphate.

To sum up, all the evidence at present strongly supports the iron-starvation theory for bush sickness, and that it is caused by deficiency of iron obtainable from the pasture, which of course means natural pasture unpurified from its attendant soil contamination. That animals may suffer from bush sickness on certain other soils growing similar iron-deficient pasture, unless they obtain iron by eating the soil, is a possibility; but in these cases the contamination iron is in a more available state than it is in pumice soils, where it occurs as an iron silicate soluble to some extent in the strong fuming hydrochloric acid used in the ash analysis at the laboratory, but insoluble in the weak juices of the ruminant's digestive system. In most normal soils the iron is largely present in a colloidal form or as oxide of iron, and ruminants might gain some advantage from this impurity when the grass was abnormally low in iron.

In the case of Kenya "nakuruitis," which according to Dr. Orr appears to be of the same nature as bush sickness, one would expect that owing to the long periods without rain and with wind in that colony a pasture would be highly contaminated by volcanic dust. If this is so, it has shown no sign of helping the animal over its progressive anæmia. An extensive experiment carried out with cattle in Kenya showed that production in terms of live weight depended upon the amount of iron oxide which the animals received as a lick. Thus the control group lost 33 lb., the group getting low amounts of iron lost 10 lb., the group getting a medium amount of iron gained 55 lb., and the group getting a high amount of iron gained 126 lb. each. Experiments at this laboratory, under glass and under scrim, have shown that in a windy situation it is practically impossible to grow pasture without contamination by atmospheric dust.

The use of iron lick in the bush-sick districts is steadily increasing, the oxide of iron (limonite) from Onekaka, Nelson, obtained by the writer in December, 1924, and specially ground for him, was unfortunately too coarsely ground, and even when mixed with salt the sheep refused to eat it. However, a much softer and finer hydrated oxide (limonite) has subsequently been obtained from the Whangarei deposit, and this is giving satisfactory results with both sheep and cattle when used as a salt lick. It contains twice the amount of iron which the carbonate of iron contains and is much easier to obtain. The Huntly spathic iron ore (impure carbonate of iron) is therefore being

replaced by this alternative choice from New Zealand sources of iron for use in the automatic treatment to combat bush sickness by means of licks.*

Hay and ensilage made with salt will present a greater and more available iron ration to the animal than the pasture it was made from. This generalization also applies to wilted and fermented grass, which is also possibly more palatable and certainly more concentrated than the original pasture. It is not generally realized that the cow's capacity is about 1 cwt. of pasture per day, and if the pasture only contains half the normal amount of iron, as is the case with the worst bush-sick pasture, it is seen that it will be impossible for the cow to overtake the deficiency by eating more pasture.

Experimenters are gradually coming to the conclusion that the amount of iron necessary for the support of animal life is greater than was hitherto thought. From researches at the Rowett Institute it is certain that pigs suffer from deficient amounts of iron in the diet when the quantity and quality of food is apparently sufficient. Rats are said by Levin and others (*Journal of Nutrition*, November, 1931) to require between 0·17 and 0·31 of a milligram of iron per day, a comparatively high amount. Orr ("Importance of Mineral Matter in Nutrition," Trans. High. Ag. Soc., 1923) states that the best guide to the amounts and proportions of minerals required by animals (other than lime and phosphoric acid, which are approximately known) is to be found in the composition in the ash of the milk of the species. The qualification, however, is made that milk is deficient in iron, the young being born with a store of iron in the body. The sheep and the pig are similar in size and in increasing in weight at approximately the same rate when they are growing fastest, and in the amount of iron found in the mothers' milk (Godden, *Journal of State Medicine*, September, 1931). On examining the following tabular matter given in his paper it will be hard to resist the conclusion that if pigs can suffer from lack of iron in the food, especially when grazing, sheep may do so also.

Species.	Number of Days in which Weight of New-born Animal is doubled.	Percentage of Ferric Oxide contained in Milk Ash of Species.
Man	180	0·0006
Horse ..	60	0·0014
Cow	47	0·0021
Goat	22	0·0022
Sheep ..	15	0·0091
Pig	14	0·0089

In conclusion, it may be said that the deficiency diseases (not peculiar to volcanic soils as some suppose) variously known as "bush sickness" in New Zealand, "pining," "vinquish," and "daising" in Scotland, "nakuruitis" in Kenya, "coast disease" in Tasmania, and "salt sick" in Florida, are probably all due to the same cause and curable by the same means as adopted in New Zealand. However this may be, it is certain in the writer's mind that the trouble as it occurs in the coarse pumice soils is preventable by a salt-iron oxide lick and curable by citrate of ammonia and iron.

* This Whangarei oxide of iron is obtainable from N. M. Keane, Fenton St., Rotorua, at 9s. per hundredweight; and the citrate from the Agriculture Department's offices at Rotorua and Tauranga, at 3s. per pound.

COMMERCIAL FERTILIZERS AND THEIR BASIS OF SALE.

IV. BONE PRODUCTS AND ORGANIC NITROGENOUS MANURES.

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BONEDUST, dried blood, blood and bone, tankage, and allied types of phospho-nitrogenous manures manufactured from animal residues derived from meat-freezing works, slaughterhouses, and similar establishments for a long time occupied the premier place in the early fertilizer industry. In addition to these, the world's agriculture has in the past consumed large quantities of nitrogenous guanos collected from numerous sources. Fish fertilizers recovered from the fishing industries have also been used by almost all agricultural countries since very early times.

The general utilization of such products to-day, however, is small when compared with the vast consumption of the chemical class of commercial plant-foods, such as superphosphate and sulphate of ammonia. In fact, the development of the manufacture of chemical fertilizers furnishing one or more essential elements of fertility has been largely responsible for the gradually diminishing consumption and importance on the market of the phospho-nitrogenous class of manures mostly of animal origin. Gray, an international authority on commercial fertilizers, has estimated the world's consumption of bone products for agricultural purposes in the year 1928 as 350,000 tons, or under 3 per cent. of the world's total phosphoric acid plant-food consumption.

An interesting and important factor bearing on the relatively diminishing supply of these animal residues for the fertilizer industry lies in their increasing use as ingredients in stock foods and licks. Much of the tankage, for instance, is now diverted to the manufacture of various grades of meat-meal, while bonemeal or boneflour go to supply dietary deficiencies on the farm.

TYPES OF BONE PRODUCTS ON THE MARKET.

BONEMEAL OR BONEDUST.

Fresh dried raw bones consist principally of organic (nitrogenous) matter, fat, and what is chemically termed tricalcium phosphate. This is also styled bone phosphate of lime, being the more established trade term denoting the main fertilizer compound combining the important mineral elements calcium (lime) and phosphorus, which enter into the nutrition of plant and animal life. For the most part, the value of fat-extracted bones as fertilizer is centred on the content of phosphoric acid plant-food present in the form of phosphate of lime, and to a smaller extent on the nitrogenous content. Thus they are purchased on this basis and classed usually as phospho-nitrogenous manures.

In order to render the phosphatic and nitrogenous ingredients more available for plant-life, pulverization of bones to a fine dusty powder is most essential. Even in the earlier days of the fertilizer industry it became customary to boil or steam fresh raw bones before grinding,

in order to deprive them of fat and to leave intact as far as possible the nitrogenous organic matter useful to some extent as plant-food. Occasionally, however, bones are ground without any preliminary treatment for direct application to the land, but the presence of fat is a drawback to the production of a fine meal, tending, as well, to hinder the decomposition of the phosphatic and nitrogenous fertilizing compounds of bone in the soil.

The plant-food content of average high-grade commercial bonedust of fine grist is somewhere near 3 to 4 per cent. of water-insoluble nitrogen (67 lb. to 90 lb. per ton) and 20 to 25 per cent. of water-insoluble phosphoric acid (448 lb. to 560 lb. per ton). With regard to mechanical condition of bone manures sold locally, it may be said that no fineness-of-grinding standard is prescribed under the New Zealand Fertilizers Act, but certain British authorities apparently consider that what is to be sold as bonemeal for fertilizer usage should all pass through a ⅛-in.-mesh screen. In the absence of any standards prescribing fineness (such as exist in South Africa and Queensland) the term bonedust is often loosely applied to any type of bone material that has been submitted to a grinding-mill.

While on the question of standards it may be mentioned that it is not uncommon for animal organic substances of a fertilizing strength of 6 or more per cent. of nitrogen and 15 per cent. or less of phosphoric acid to be sold as bonedust; but this description is scarcely applicable when the nitrogen content is higher than 4½ per cent. In cases of this kind, the term bone tankage is preferable. If the mixture consisted of dried blood mixed with bone, the description blood and bone would apply. Here again, in the absence of standards under the fertilizer law defining the precise meaning of the terms "bonedust" or "blood and bone," uniformity in regard to descriptive terms in the fertilizer trade is rendered difficult.

STEAMED BONEMEAL.

This material results from steaming bones under high pressure, the object of which, in the first instance, is to remove the superfluous fatty matter valuable for the manufacture of soap, candles, and glycerine, and, in the second instance, to deprive the bones of most of the nitrogenous matter (ossein) useful to gelatine and glue manufacturers. After the residual product is well dried, it is then more easily crushed to a meal or dust. When ground to a very fine powder—that is, if all the material will pass, say, a 50-mesh sieve—the product is termed steamed bone-flour, although it seems that the name is at times indiscriminately applied to steamed bone products of a somewhat coarser texture.

It should be pointed out that while steamed boneflour is still used as a fertilizer, it appears to be steadily growing in favour for supplying the mineral elements lime and phosphorus in well-balanced form as supplements to the rations of cattle and sheep, especially on droughty soils or soils subject to droughty seasons, and on some types of back-country hill pastures where top-dressing with phosphate and lime containing fertilizers is impracticable.

In the course of extracting organic matter from bones the nitrogen content is lowered, but the effect is a proportional increase in the phosphoric-acid content. High-grade samples of steamed bonemeal may contain 1·5 to 3 per cent. of water-insoluble nitrogen (33 lb. to 67 lb.

per ton) and 22 to 27 per cent. (493 lb. to 605 lb. per ton), or even more, of water-insoluble phosphoric acid, which, as already mentioned, is higher when the nitrogen content is low and the reverse when the nitrogen is higher. By reason of the percentage of nitrogen in both steamed bonemeal and boneflour being so small, they are often classed purely as phosphatic rather than as phospho-nitrogenous manures.

The particular merit of fine-gristed steamed bonemeal seems to lie not only in the comparative ease with which it decomposes when harrowed into certain classes of light-textured soil, but also in its power as an excellent drying agent when introduced into mixtures with other fertilizers. Steamed bonemeal prevents caking and hardening, and therefore serves to improve the mechanical condition of fertilizer mixtures for drilling in with seed. With superphosphate, for example, steamed bonemeal or steamed boneflour forms an excellent combination.

The constituents of animal bones vary considerably according to their source and condition, but the following analyses by Thomas Lambert (" Bone Products and Manures ") afford some idea of their make-up :—

	Boiled Bones. Per Cent.	Steamed Bones. Per Cent.
Moisture	10·81	10·79
Organic matter*	25·97	22·48
Phosphate of lime†	53·15	57·17
Magnesia and carbonate of lime	6·28	6·89
Oxide of iron	0·27	Trace
Alkaline salts‡	1·07	0·86
Sand (silica)	2·45	1·74
	100·00	100·00
* Containing nitrogen	1·91	1·64
Equal to ammonia	2·31	1·99
† Equal to phosphoric acid	24·30	26·18

‡ Includes traces of alkaline compounds of sodium, fluorine, and chlorine.

Reference may also be made to the fact that bonemeal is at times distinguished in the fertilizer trade according to whether it has been made from steam - treated bones or chemically - treated bones. For instance, the more modern benzine process followed by boiling is resorted to for the extraction of fat and other useful matter from bones in preference to the boiling or steaming process. Apparently the quality of the meal produced by the former method is superior to that produced by the latter.

BONE CHAR.

Bone char, also known as bone charcoal, is the name given to a form of residual charcoal produced when bones are heated in closed iron cylinders. It is employed for refining (decolorizing) sugar and oil, and when used several times its action becomes weakened. Finally, it is sold under names such as " spent char," " char dust," or " animal charcoal dust," to fertilizer-mixers. Limited amounts of both locally produced and imported char dust from some of the older types of sugar-refining plants are employed in the making of commercially mixed fertilizers.

Spent bone char dust is essentially a phosphatic product, containing 27 to 32 per cent. or more of (insoluble in water) phosphoric acid.

Only an insignificant amount of nitrogen, from 1 to 1½ per cent. or less, is present in its composition. In parts of Australia and elsewhere this material is in popular demand for incorporating in mineral stock-licks, being rich in lime phosphate. Its popularity in this direction is also partly due to its charcoal content, considered to be a useful adjunct to licks. In all probability the increasing employment of the limited quantities available for lick-making will eventually preclude its use in the fertilizer trade.

OTHER BONE-PRODUCTS.

Whale-bonemeal or whale-bonedust is made in small quantities from whale-bones obtained from the small whaling-stations of Wekinui (Marlborough) and Whangamumu (North Auckland). Both products have a similar plant-food composition, the average being set out in Table 1.

Bone-ash or calcined bone, consisting of the mineral matter remaining when bones are burnt, was at one time used as a phosphatic fertilizer, principally in Europe and America. It was also used to a small extent in the making of chemical fertilizer, being treated with sulphuric acid to make a form of superphosphate. Bone-ash contains 34 to 38 per cent. of phosphoric acid and appears to be employed overseas to a certain extent in the compounding of mineral stock-licks. A little calcined bone is on sale locally for fertilizing home gardens.

Dissolved bone (vitriolized bone or bone superphosphate) is not retailed in New Zealand, but many years ago was quite popular as a fertilizer, especially in European countries. To-day it is rarely made. The manufacture of dissolved bone is conducted on similar lines to that of superphosphate· chemically prepared at much less cost from natural rock phosphate. The reason for treating ground bone or bonemeal with sulphuric acid is to render the bone phosphate into a more available form for crops.

Precipitated bone, a white powder consisting principally of dicalcium or reverted phosphate, is another by-product available from the manufacture of glue from bones. In the United States of America small quantities available are, it seems, now used more for making stock-licks than as fertilizer. It contains about 40 per cent. of water-insoluble phosphoric acid.

IMPORTATIONS OF BONEDUST.

Importations of bonedust into New Zealand were at one time a leading feature. From April, 1910, to March, 1931, roundly 175,000 tons were landed here. Importations, however, have steadily dropped from 4,063 tons in 1921–22 to 795 tons in 1930–31, the total imports for the ten years ended March, 1931, being only 20,503 tons.

COMMERCIAL ORGANIC MANURES.

DRIED BLOOD.

Dried blood is prepared by steam-heating, drying, and grinding the collected blood of slaughtered animals. The better qualities—in the United States of America, for example—are in some cases used for buttonmaking, while the poorer grades find an outlet in commerce as nitrogenous manures. In Australia and New Zealand latterly there

appears to have been a trend towards the use of dried blood in the preparation of stock-foods and, as already noted, it is quite likely that quantities used for fertilizer purposes will go on gradually diminishing in the future.

Table 1.—Plant-food Composition of Bonedust, Blood, Blood and Bone, and other similar Manures sold in New Zealand.

Designation of Product.	Number of Registered Brands.	Average Percentage of Registered Fertilizing Ingredients.		Range of Percentage of Fertilizing Ingredients.	
		Nitrogen (insoluble in Water).	Phosphoric Acid (insoluble in Water).	Nitrogen (insoluble in Water).	Phosphoric Acid (insoluble in Water).
Bonedust	57	3·5	21·9	2·3 to 4·3	17·2 to 27·2
Dried blood ..	18	12·6	..	12·0 to 14·0	..
Blood and bone manure	66	6·6	11·7	4·7 to 8·5	8·2 to 21 9
Meat and bone manure	2	7·3	11·5	6·5 to 8·0	10·0 to 13·0
Bone tankage ..	1	8·0	10·0	..	..
Bone mixture (tankage)	1	4·6	18·8	..	..
Bone fertilizer (bones chemically treated)	1	3·3	20·5	..	..
Bone-char dust (or animal charcoal dust)	3	..	29·0	..	27·5 to 32·0
Whale-bonemeal (or whale-bonedust)	2	2·9	22·5	..	..
Fish fertilizer ..	2	5·8	12·8	..	..

Remarks on Production, &c.

According to New Zealand factory-production statistics, there were forty meat-freezing and meat-preserving works operating in the Dominion in 1928, 1929, and 1930. These establishments, apart from their main product of meat, treat a number of valuable by-products, including manure. The combined output of manurial by-products for the years stated was as follows:—

Year.	Bonedust and Bone Manure.	Value.	Blood Manure.	Value.	Blood and Bone Manure.	Value.	Other Manure.†	Value.
	Tons.	£	Tons.	£	Tons.	£	Tons.	£
1928 ..	9,696	73,088	*	*	*	*	20,491	135,684
1929 ..	2,657	24,400	*	*	14,013	105,142	15,082	88,942
1930 ..	3,351	32,106	2,707	25,034	8,178	67,585	17,203	104,499

* Included in "Other Manure." † Presumably compound mixtures prepared at these works.

Boiling-down works also utilize animal waste for conversion into manure, &c. The number of such plants in operation during 1928, 1929, and 1930 is given as 36, 34, and 29 respectively, the production of manures alone being as below:—

Year.	Bonedust.	Value.	Blood.	Value.	Other Manure.	Value.
	Tons.	£	Tons.	£	Tons.	£
1928 ..	2,999	24,620	955	7,135	1,660	10,100
1929 ..	2,847	22,814	699	5,202	2,690	17,055
1930 ..	1,691	14,959	469	3,999	1,391	13,672

Blood-meal, a more refined form of dried blood, is a very highly concentrated commercial stock-food, containing 75 per cent. or more of crude protein (equivalent to 12 per cent. or more of nitrogen), used in similar fashion to meat-meal. Fresh blood is not sold as commercial fertilizer, as it contains a high percentage of water and decomposes quickly.

Dried blood appears on the market as a slightly moist dark-reddish meal or powder, with a characteristic but not very pronounced odour. Generally the opinion is that the nitrogen in blood is worth far more per unit than, for instance, the nitrogen in coarse bone-meal. For a long time it was considered the most valuable of all organic nitrogenous manures, but for several years now synthetically prepared urea, a concentrated chemical preparation of German origin containing 46 per cent. (1,030 lb. per ton) of water-soluble nitrogen in organic form, has been on the market at low unit cost.

Though small users cannot employ dried blood in quite the same manner as the quicker-acting water-soluble salts, nitrate of soda and sulphate of ammonia, nevertheless the former has long been found to be suitable when well harrowed into the soil before planting for a large variety of market-garden crops during their growing period, when a steady supply of nitrogenous plant-food is desirable. In addition, there is little chance for the organic nitrogen as supplied in dried blood being carried away through soil-drainage. Mixtures of dried blood with bonedust therefore enjoy a wide measure of favour among market-gardeners, orchardists, hop-growers, &c., as safe, convenient manures. The demand for dried blood as manure has been, of course, principally for blending or mixing with other agents; in this direction it can be used with a wide range of materials.

In quality, dried blood has a range of from 9 to 14 per cent. (202 lb. to 314 lb. per ton) of water-insoluble nitrogen, although, with one exception, in this country the limits are narrower, being 12 to 14 per cent. (269 lb. to 314 lb. per ton) in respect of the several brands registered.

BLOOD AND BONE.

This, strictly speaking, is a mechanical mixture of dried blood and crushed bone; nevertheless, there are on the market several commercial grades of what is loosely styled "blood and bone" made from animal flesh, viscera, &c., from the rendering-plant, in addition to bone or perhaps blood. The designation "tankage" would be much more suitable in cases where the mixture is not entirely composed of dried blood plus bone.

Blood and bone is a "general-purpose" product suitable for almost any type of crop where a manure is desired which will not force growth too quickly. New Zealand brands, containing from 4·2 to 8·5 per cent. of nitrogen and 8·2 to 21·9 per cent. of phosphoric acid, are largely employed for conversion into compound manures—in fact, most of the proprietary mixtures on the local fertilizer market contain varying amounts of blood and bone or animal matter of some description or other. An undoubted advantage attaching to the use of blood and bone lies in the fact that it can be mixed with any class of fertilizer materials without causing reversion of the phosphoric acid or liberation of free ammonia.

TANKAGE.

Tankage is a meal of brownish colour, and, like most animal manures, has a characteristic smell. It comes under the heading of phospho-nitrogenous manures, being manufactured from animal refuse of a heterogeneous character such as blood, bone, intestines, hoofs, horns, meat-scraps, hair, hides, and carcasses of condemned animals, which are efficiently cooked under pressure in large tanks or digesters to remove fatty matter, &c., and at the same time to render the ultimate product more available as plant-food. After the material is removed from the digester it is dried and ground.

In the soil the action of tankage is practically the same as blood and bone, except that its plant-food is generally reckoned to be more slowly available than that of the latter. Tankage is not a standardized product; composition is exceedingly variable, typical analyses indicating a content of 5 to 10 per cent. of water-insoluble nitrogen (112 lb. to 224 lb. per ton) and from 5 to 12 per cent. or thereabouts (112 lb. to 269 lb. per ton) of water-insoluble phosphoric acid. As a conditioner or drier in fertilizer mixtures tankage has a considerable value because of its advantage in tending to correct hygroscopicity of other fertilizers, thus enabling mixtures of good drilling quality to be made.

The description "tankage" covers a fairly wide range of materials from the rendering-plant. Often it has a qualifying term, such as bone tankage (*i.e.*, if it contains a high proportion of bone, but has too much meat to be called bonemeal), meat and bone tankage, animal tankage, garbage tankage, &c. What is known as meat-and-bone meal in England and meat and bone (or even blood and bone) in New Zealand, for instance, is covered by the wider and more general term "tankage" in the United States and Canada.

Digester tankage for stock-feeding purposes must not be confused with fertilizer tankage. In Queensland, for example, the former is held to consist of the residue from animal tissue exclusive of hoof and horn, specially prepared for feeding purposes by tanking under live steam, drying under high heat, and suitable grinding. If the residue contains more than 10 per cent. of phosphoric acid it is designated meat-and-bone tankage.

MEAT-MEAL.

Meat-meal, made from meat refuse, cooked, dried, and ground, is sold to a very limited extent as a manure. The plant-food composition is variable; certain high-grade types may yield 10 to 12 per cent. of nitrogen and 1 to 5 per cent. of phosphoric acid.

Various grades of meat-meal, in the form of brown powder with a sweet nutty smell, prepared in modern dry-rendering plants from livers, hearts, and other clean trimmings of stock slaughtered for human consumption, are commanding attention in the field of animal nutrition. Experimental evidence points unmistakably to the suitability and value of these easily digested protein by-products for stock-raising. Most of the high-grade meat-meals on the local market as feeding-stuffs contain 60 to 65 per cent. of protein (9·6 to 10·4 per cent. of nitrogen) together with minor proportions of fat and phosphoric acid.

MEAT AND BONE.

Two brands of meat-and-bone manure—with fertilizing strengths of 6½ per cent. nitrogen and 13 per cent. phosphoric acid, and 8 per cent. nitrogen and 10 per cent. phosphoric acid respectively—are registered for local sale.

Meat-meal and bone-meal for feeding purposes generally contain less protein than meat-meal—typical samples yielding 47 to 52 per cent. (7·5 to 8·3 per cent. of nitrogen) or thereabouts, and in the vicinity of 12 per cent. of phosphoric acid (26·2 per cent. tricalcium phosphate of lime).

FISH FERTILIZER (FISH GUANO, GROUND FISH-SCRAP, FISH TANKAGE).

This is the product rendered from non-edible fish, offals, intestines, heads, tails, bones, and other fish-waste, which is dried and crushed or finely ground after being treated under steam pressure* to remove the fish oil, valuable in other commercial channels but most undesirable in the fertilizer. Fish fertilizer is more particularly valued for its organic nitrogen, which usually ranges between 6 and 10 per cent. The actual phosphoric-acid content may only amount to a percentage of some 4 to 8.

A superior fish-meal is prepared from both edible and suitable classes of non-edible trawler-caught fish and better-class fish-waste, which is sterilized under high pressure. It contains practically none of the objectionable fish oil liable to impart a taste to milk, butter, cheese, eggs, and meat, and commands a good price on the market as poultry or stock food. The building of floating fish-meal factories has received or is receiving attention in various countries.

Fish fertilizer and fish-fertilizer mixtures have been on the New Zealand market in limited quantities for general manurial purposes for some years past. Dressings of this particular class of manure have given highly favourable results in Nelson apple orchards. The quality of fish fertilizer manufactured near Auckland is declared for selling purposes at 6 per cent. of insoluble nitrogen and 12·5 per cent. of water-insoluble phosphoric acid.

WHALE GUANO (WHALE MEAT AND BLOOD, WHALE TANKAGE).

This residual by-product of the whaling industry may contain between 6 and 11 per cent. of nitrogen and from 2 to 4 per cent. of phosphoric acid. It is, however, not sold at present on the local market. The prolific whale life of the waters in our Ross Dependency—of late years exploited on a very large scale for whale oil by Norwegian interests—may ultimately afford an auxiliary source of useful organic by-products for New Zealand's agriculture.

SEA-BIRD GUANO.

Certain forms of guano are a rich source of organic nitrogen, but it should be observed that the term "guano" is not always confined to the excrementitious deposits and remains of birds living on fish and

* The benzine process is also adopted for extraction of fish oil, &c. Occasionally fish-scrap is treated with sulphuric acid for rendering fertilizer ingredients more available.

other marine life. In the fertilizer trade overseas it is customary to apply some qualifying term or adjective to the word guano to define certain types of organic fertilizer, such as phospho-guano, whale guano, fish guano, animal guano, Peruvian guano, and bat guano. Generally, the designation " guano " in itself is confined to nitrogenous sea-bird or bat guano from natural deposits containing, say, 4 per cent. or more of nitrogen, 11 per cent. or more of phosphoric acid, and 1 to 2 per cent. of potash. Phosphatic guano is the term applied to well-leached guano, containing in the vicinity of 1 to 3 per cent. of water-insoluble nitrogen and from 12 per cent. upwards of water-insoluble phosphoric acid. In the case of material containing, say, 12 to 40 per cent. of insoluble phosphoric acid and less than 1 per cent. of insoluble nitrogen, the designation " rock phosphate " is more appropriate.

As an all-round manure, high-quality unadulterated nitrogenous sea-bird guano was at one period probably the most popular material on the market, but its present use is restricted on account of the high price and the difficulty of obtaining regular supplies of the genuine material. The composition of sea-bird guano is exceedingly variable, being dependent upon the climate of the region in which it is found. In an exceptionally dry district this dung will contain a good proportion of nitrogen, potash, and even a little of its phosphoric acid in water-soluble form ; but in a locality where rains occur, the nitrogen and potash may almost all be leached out, leaving residues containing insoluble (tricalcium) phosphate. Here the term " phosphatic guano " or " rock phosphate " is preferable to the term " guano." In a guano which has not been subjected to leaching action, the nitrogen exists in small proportions as ammoniacal salts, nitrates, and salts of uric and other organic acids. In consequence of possessing this nitrogenous matter, on which the main value is placed, true guano is classed as a nitrogenous fertilizer.

The best-known deposits of decomposed sea-bird excreta are found on numerous barren, rainless islands off the coast of Peru, the material collected from this source being sold under the designation of " genuine Peruvian guano." Another well-known source furnishing supplies of high-grade nitrogenous guano is the Ichaboen islands off the coast of Africa. The best quality Peruvian raw bird-guano contains as high as 13 per cent. or even more of nitrogen and about 11 or 12 per cent. of phosphoric acid, mostly water-insoluble ; a little potash is also present.

Special grades of guano—Peruvian, for example—are now and then treated with sulphuric acid with the object of preventing volatile ammonia (nitrogen) from escaping, and at the same time to render the bulk of the phosphoric acid in the guano soluble in water. Guano so treated is known as " dissolved guano," and typical samples may yield 9 to 10 per cent. of phosphoric acid, in addition to 4½ to 7 per cent. or more or nitrogen and 1 to 2 per cent. of potash. Imported material sold under the designations of Peruvian guano and dissolved guano respectively are sold in small quantities by New Zealand merchants.

MISCELLANEOUS ORGANIC WASTE PRODUCTS.

A considerable variety of trade-waste materials, mostly of animal origin, are available in fairly large quantities in a number of overseas countries. Such materials include hoof and horn, leather waste, wool

waste, shoddy, rabbit-fur waste, felt, house garbage, sewage sludge, &c. These all contain varying proportions of nitrogen in organic form and in some cases appreciable amounts of phosphoric acid. Unless subjected to some such treatment as steaming under pressure, drying, and grinding to increase the availability or fertilizing power of their nitrogenous matter, &c., materials of this class, although rich in nitrogen, may often be so resistant in their natural state to the agencies of decomposition that they will lie inert in the soil for years. As a matter of fact, the availability of all organic manures is more or less dependent upon the nature of the soil and the character of the season.

The cost of converting waste matter into merchantable products suitable, say, for the makers of horticultural and market-garden manures is often excessive. In fact, the utilization of many forms of industrial waste materials for the manufacture or conditioning of commercial fertilizers rests mainly on the question of costs. If the finished article can be produced at a reasonable price and is of sufficiently good quality to repay the cost of short-distance transportation, there should be no need for waste of organic manure materials of any description.

Undoubtedly slow-acting organic manures have under special conditions of market-garden and horticultural practice some value for soil-improvement, even though they be bulky and inferior in quality and action to the standard organic manures such as dried blood. It is, of course, well recognized that to compensate for the substitution of slower-acting manures of low analysis larger applications are necessary.

Use of the Terms "Nitrogen" and "Ammonia."

With the growing use of chemical language in fertilizer terminology, there is always liable to be some confusion as regards the various methods employed in stating the plant-food value of fertilizers. A notable example is to be seen in the use of the terms "nitrogen" and "ammonia" relative to the class of fertilizer here under discussion.

The term nitrogen (symbolized by the letter N) denotes an element universally accepted as one of the plant-food essentials. Under the Fertilizers Act its percentage in any grade of commercial fertilizer must be disclosed both in the registration statement filed with the Department of Agriculture and in the invoice certificate issued to the fertilizer purchaser.

Ammonia (represented by the chemical formula NH_3), a compound combining one atom of nitrogen with three atoms of hydrogen, is often employed in advertising-matter as a means of expressing the nitrogenous plant-food of a fertilizer. This method of statement appears to be favoured by certain advertisers because any percentage of nitrogen expressed in terms of ammonia gives a higher figure than if expressed as nitrogen alone. For example, 17 per cent. of ammonia is equivalent of 14 per cent. of nitrogen.

To convert ammonia into its equivalent of nitrogen the percentage of ammonia may be multiplied by 14 and the product divided by 17; conversely, to express nitrogen in terms of ammonia the percentage of nitrogen is multiplied by 17 and the product divided by 14. Following is an example: A certain brand of blood-and-bone manure is advertised for sale to contain 5 per cent. of ammonia. Expressed in terms of nitrogen the percentage is 4·1, found by the following calculation:

$(5 \times 14) \div 17 = 4{\cdot}1$ per cent. Conversely, if the blood and bone is guaranteed to contain 4·1 per cent. of nitrogen, it contains the equivalent of 5 per cent. of ammonia. In other words, 4·1 lb. of nitrogen yield on decomposition in the soil 5 lb. of ammonia. As an alternative, ammonia may be converted into nitrogen by multiplying by the factor 0·8225, and nitrogen into ammonia by multiplying by the factor 1·214.

A useful range of percentages of ammonia and their equivalents in terms of nitrogen is given in Table 2. Similar tables for converting percentages of tricalcium phosphate into their equivalents of phosphoric acid were published in the *Journal* for May and July, 1931, in the articles on basic slag and superphosphate respectively.

Table 2.—Equivalents of Ammonia in Terms of Nitrogen.

Percentage of Ammonia.	Equivalent Percentage of Nitrogen.	Percentage of Ammonia.	Equivalent Percentage of Nitrogen.
1	0·8	16	13·2
2	1·6	17	14·0
3	2·5	18	14·8
4	3·3	19	15·6
5	4·1	20	16·5
6	4·9	21	17·3
7	5·8	22	18·1
8	6·6	23	18·9
9	7·4	24	19·7
10	8·2	25	20·6
11	9·0	26	21·4
12	9·9	27	22 2
13	10·7	28	23·0
14	11·5	29	23·9
15	12·3	30	24·7

(Series to be continued.)

PARASITES FOR CONTROL OF CABBAGE BUTTERFLY.

In the *Journal* for June, 1931, was published an illustrated article on "Pieris rapae: A recently introduced Cabbage Pest," by Mr. J. Muggeridge, Entomologist, Plant Research Station, giving the life-history of the insect, methods of control, &c. There is little doubt that Pieris rapae, which was first noticed at Napier, has now become well established in Hawke's Bay, and it appears to be steadily spreading in the North Island. Specimens have lately been received by the Entomologist for identification from Te Puke, Waiotapu, and Dannevirke. In his article Mr. Muggeridge mentioned *Apanteles glomeratus* as one of the most important insect parasites of Pieris rapae. In response to a request, the Imperial Institute of Entomology, London, has now forwarded to the Plant Research Station some 3,000 puparia of *A. glomeratus*, and this material will be used for breeding up supplies of the parasite for distribution. There are good reasons for believing that, once established, this parasite will considerably reduce the depredations of the pest. Apart from biological control, however, Pieris rapae may be controlled by sprays, some particulars of which were given in the article referred to.

CORTICIUM DISEASE OF POTATOES.

IV. CONTROL TREATMENTS SHOWN TO BE NOT WARRANTED UNDER NEW ZEALAND CONDITIONS.

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WITHIN the last few years several workers have questioned the value of seed-treatments for the control of corticium disease of potatoes. White (1927) gave an account of co-operative experiments on control of corticium carried out in several parts of the United States of America during the 1926 season. In four of the States the percentage of clean sprouts in the various plots was determined, and sprout-injury in Florida was found to be very low. No general correlation could be established between increased yield and a high percentage of clean sprouts. Clayton (1929) after four years' work on corticium control came to the conclusion that the prevalence of soil-infection on Long Island, New York, made seed-treatment scarcely profitable. Treatments with mercury compounds gave an increased yield of 2 per cent., which did not warrant seed-treatment. Gratz (1930) recorded that corticium was more evident in Maine than in Florida, where the incidence of stem cankers is comparatively low. In a later paper of the same year he gives an account of six years' experiments in the Hastings potato belt, Florida, on the control of corticium. The results of these experiments indicate that seed-treatment is unwarranted, for, while few significant increases in yield were obtained, numerous cases of actual reduction were recorded as a result of treatment. Schlumberger (1930) states that in 1930 corticium caused little reduction in yield of potato crops in Germany, and he considers that exaggerated importance is attached to the pitting injury of the tubers caused by this fungus. In a later paper (1931) he says that potatoes should not be rejected from certification on account of corticium unless the bulk of the tubers are heavily infected.

EFFECT OF CORTICIUM ON YIELD IN NEW ZEALAND.

A series of trials was carried out at the Plant Research Station during the 1930–31 season for the purpose of testing various treatments and to obtain some idea as to the effect of corticium on yield. The treatments were carried out fifteen weeks before planting. The hundred tubers of each treatment were planted in ten replications of ten tubers per plot. Results were as follows:—

Table 1.

Type of Sets.	Number of Sets.	Strength of Acidulated Corrosive Sublimate.	Length of Soak in Minutes.	Percentage of Corticium Infection.	Yield of Table plus Seed in Tons per Acre.
Seed, corticium-infected ..	100	..	..	73	8·5
Seed, picked clean ..	300	..	..	2·3	7·7
Seed, corticium-infected ..	100	1–1,000*	120	13	6·4
,, ..	100	1–6·6–1,000	90	12	7·9
,, ..	100	1–10–500	5	12	8·3

* This treatment is the old standard treatment—1 part corrosive sublimate and 1,000 parts water—while all the others are acidulated, the amount of acid present being denoted thus: 1–6·6–1,000 = 1 part corrosive sublimate, 6·6 parts hydrochloric acid, and 1,000 parts water.

Table 1—continued.

Type of Sets.	Mumber of Sets.	Strength of Acidulated Corrosive Sublimate.	Length of Soak in Minutes.	Percentage of Corticium Infection.	Yield of Table plus Seed in Tons per Acre.
Seed corticium-infected ..	100	1–10–500	20	9	8·6
,, ..	100	1–10–500	90	5	7·2
Seed, picked clean ..	100	1–6·6–1,000	90	2	9·8
Cut table, corticium-infected	200	..	..	53	5·9
,, ,,	100	1–6·6–600	60	7	7·5
,, ,,	100	1–6·6–500	60	10	8·4
,, ,,	100	1–6·6–800	90	13	6·7
,, ,,	100	1–10–700	60	7	6·5

Of the nine treatments tested on corticium-infected potatoes only two produced a significant increase in yield, while one actually produced a significant reduction. A comparison of the picked clean seed and the corticium-infected seed shows that the infected seed yielded slightly better than the clean, although the difference was not significant. From the consideration of these results it seems that corticium is having but little effect on yield.

Stimulating Effect of Organic Mercury Compounds on the Growth of Potatoes.

Certain chemicals have a stimulating effect on the growth of potato tubers, as is shown by the work of Denny (1926) on the breaking of their dormant period. From the results of one year's experiments here with certain organic mercury compounds it appears that, although they were not efficient in controlling corticium, they did have a stimulating effect on the growth of the plants. The organic mercury compounds in question were Semesan Bel, Cal-K, and No. 664, all products of E.I. du Pont de Nemours and Co. The results are shown graphically in Fig. 2, in which the rates of germination in the treated and untreated lines are compared.

The treatments also had a decided influence on the yields, as may be seen from Table 2.

Table 2.

Treatment.	Strength.	Length of Dip.	Number of Sets.	Percentage of Corticium Infection.	Yield of Table plus Seed in Tons per Acre.
Control	..	..	125	70	9·2
Acid. Corrosive Sublimate	1–6·6–1,000	90 minutes ..	300	11	8·2
Cal-K	1–40 ..	Instantaneous	100	25	10·2
Semesan Bel ..	Paste ..	,,	100	71	10·9
No. 664	1–68 ..	1 minute ..	100	34	11·0

The organic-mercury treatments have here had a definite effect on germination and yield. The increased vigour of the treated plants may be further seen from Fig. 1, which shows a section of the crop thirty-two days after planting. The poor results obtained from the acidulated-corrosive-sublimate treatment was due to induced dormancy brought about by late treatment.

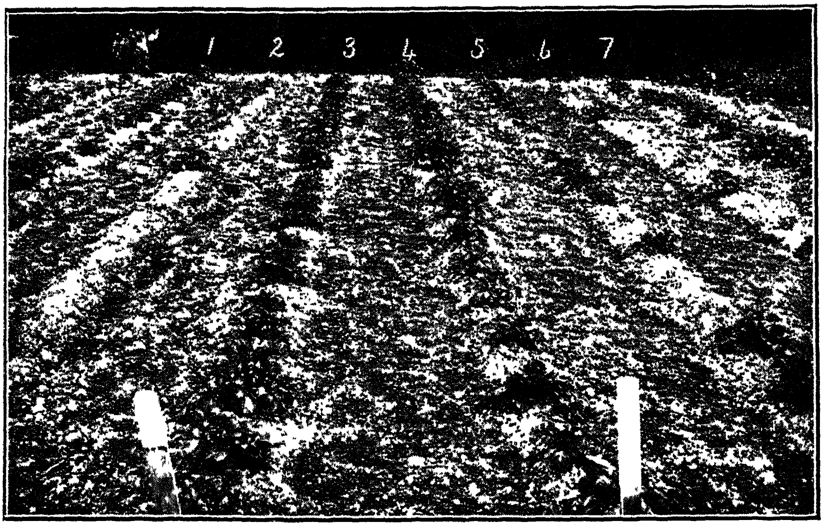

FIG. I. INCREASED VIGOUR OF PLANTS PRODUCED BY ORGANIC MERCURY TREATMENTS.

Rows 1 and 7 untreated; rows 2 and 6 treated with acidulated corrosive sublimate; row 3 treated with No. 664; row 4 treated with Semesan Bel; row 5 treated with Cal-K.

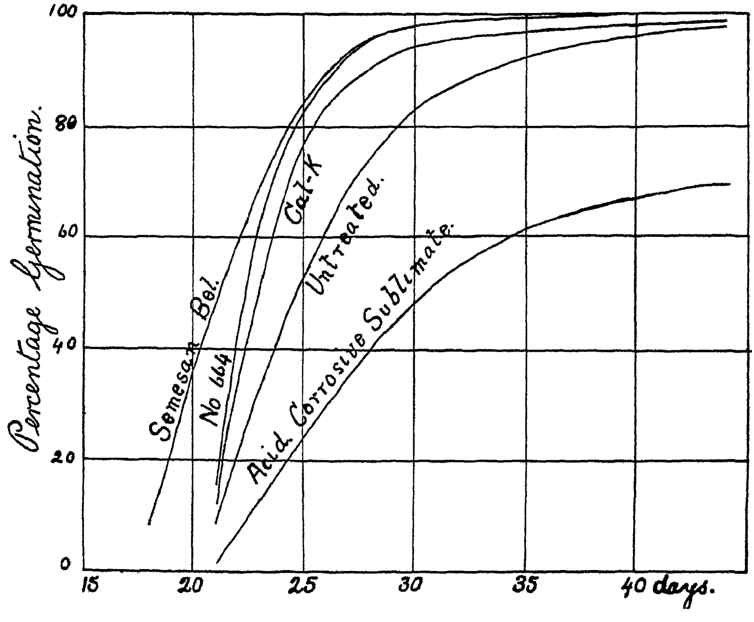

FIG. 2. GRAPH SHOWING EFFECT OF ORGANIC MERCURY TREATMENTS.

SEED-TREATMENT CONSIDERATIONS.

(1) The effect of corticium on the yield of potato crops in New Zealand is doubtful, and from the experimental evidence available it seems probable that no great reduction is caused by this disease. Corticium has not been observed to produce much pitting, cracking, or disfiguring of potato tubers. The only injury to the tubers themselves is a slightly rough appearance produced by the presence of the black sclerotia on the surface.

(2) Treatments for the control of corticium are liable to injure the potato tubers by causing pitting and bringing about an induced dormancy. Unless the treatments are carried out while the tubers are dormant they may have a detrimental effect on the yield.

(3) It has not been possible to find a treatment which will give complete control of corticium. In all, three organic-mercury treatments, the standard corrosive-sublimate treatment, and nine different acidulated-corrosive-sublimate treatments have been tested. Of these the acidulated-corrosive-sublimate treatments were the most satisfactory in controlling the disease, and the best treatment—1–10-500 acidulated corrosive sublimate, 1½-hour soak—reduced the infection from 73 per cent. to 5 per cent. This treatment, however, was so severe on the tubers that it brought about a reduction in yield, although the seed-tubers had been treated while they were dormant.

(4) If an infected line of potatoes is planted in land free from corticium the organism spreads into the soil and may infect subsequent potato crops. An experiment carried out in the South Island showed that corticium was present in the soil four years after the last crop of potatoes had been grown. At the end of this period the disease still persisted to such an extent that treated and untreated seed grown in this land showed the same percentage of infected tubers at digging-time. It is obvious, therefore, that there is no advantage in attempting to produce a line free from corticium unless one is intending to plant the seed in clean soil.

(5) Corticium spreads readily from plant to plant in the row, so that the percentage of disease within a line increases. Experiments have shown that when the sets are planted 16 in. apart the extent of the spread is 23 per cent. of the infected plants. In the field the sets are usually planted closer than this, so the spread would probably be greater. Under the circumstances, to keep a line reasonably free from corticium it would be necessary to treat every second or third year.

(6) Under certain conditions of storage corticium spreads rapidly from tuber to tuber, so that a line which at digging may have had a small percentage of infection may be heavily infected when the tubers are planted in the following season. Since even the produce of treated potatoes will show a certain amount of infection, there is a danger of the effect of treatment being entirely lost within one season.

A consideration of these facts indicates that the benefits resulting from seed-treatment are doubtful, that the treatment itself is risky and may have a detrimental effect on the yield, and that the chances of keeping a line reasonably clean without treatment every second or third year are small. Under these conditions treatment of seed potatoes by the ordinary potato-grower is not warranted.

TREATMENT FOR SPECIAL PURPOSES.

Although treatment is not recommended for general use among potato-growers, it is realized that some farmers may wish to have corticium-free potatoes for show purposes. Since no treatment could be found which gave complete control, it is suggested that any farmer wishing to obtain clean potatoes should select, from his line of seed, tubers as free as possible from sclerotia, and then treat these by the following method :—

Solution : 1 oz. corrosive sublimate, $\frac{1}{3}$ pint concentrated commercial hydrochloric acid, 6 gallons water. Time of immersion : $1\frac{1}{2}$ hours. To make up the solution, add the corrosive sublimate to the hydrochloric acid, in which it dissolves readily. When it is all dissolved, the solution is added to the water. The treatment should be carried out in a wooden or earthenware receptacle, since both corrosive sublimate and the acid attack metals, and the acid attacks concrete.

To make sure that the treatment will not injure the seed, it should be carried out before the tubers show any signs of sprouting, preferably four months or more before planting. The potatoes should be well dried before storing. If it is already late in the season, and the tubers have sprouted, injury which will follow late treatment may be lessened by treating immediately before planting.

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(Note.—The foregoing article concludes this series.)

Check Testing at Dairy Factories.—This work is referred to in the annual report of the Dairy Division for 1930–31, as follows : " The check testing at dairy factories of suppliers' samples of milk and cream for butterfat content has been considerably extended during the year, as, in addition to the two officers specially detailed for this work, the Dairy Instructors have assisted as opportunity offered. In all, 550 visits were made to dairy companies for this purpose. Dairy companies are keen to carry out the testing accurately and efficiently. Very few samples of milk and cream now come forward to the Division for testing as a check against that of the factory test, which is an indication that suppliers are satisfied that the factory testing is being carried out accurately."

HOST RANGE OF SCLEROTINIA SCLEROTIORUM IN NEW ZEALAND.

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IN New Zealand the fungus Sclerotinia sclerotiorum occurs on a wider range of plants than any other species. It will be seen from the accompanying table that the host-range in this country comprises twelve families and thirty-nine species. The fungus attacks the seed, stems, fruit, or bulbs of the tabulated species, upon which it produces round black sclerotia of variable size.

Table of Hosts and Parts affected.

Host.		Parts affected.
Botanical Name.	Common Name.	
Ranunculaceae—*Delphinium ajacis*	Larkspur	Stem.
Cruciferae—		
Brassica campestris ..	Turnip	Bulb.
Brassica napo-brassica ..	Swede	Seed, bulb, and stem.
Brassica napus	Rape	Stem.
Brassica nigra	Mustard	Stem.
Brassica oleracea var. *Ramosa*	Chou moellier ..	Stem.
Cardamine heterophylla ..	Bitter cress.. ..	Stem.
Chieranthus chieri	Wallflower	Stem.
Raphanus sativus	Radish	Bulb.
Rosaceae—		
Pyrus communis	Pear	Fruit in store.
Pyrus malus	Apple	Fruit in store.
Leguminosae—		
Glycine soja	Soy-bean	Stem.
Lupinus angustifolius ..	Blue lupin	Pods and stem.
Medicago sativa	Lucerne (alfalfa) ..	Stem.
Phaseolus vulgaris	French bean ..	Stem.
Pisum sativum	Garden pea.. ..	Pods and stem.
Vicia faba	Broad bean ..	Stem.
Rutaceae—		
Citrus aurantium	Orange	Fruit.
Citrus medica var. *limonum*	Lemon	Stem and fruit.
Malvaceae—*Lavatera arborea* ..	Tree-mallow ..	Stem.
Passifloraceae—*Passiflora edulis*	Passion-vine ..	Stem.
Umbelliferae—		
Daucus carota	Carrot	Bulb.
Pastinaca sativa	Parsnip	Bulb.
Solanaceae—		
Lycopersicum esculentum ..	Tomato	Fruit and stem.
Nicotiana tabacum ..	Tobacco	Stem.
Solanum tuberosum ..	Potato	Stem.
Scrophulariaceae — *Antirrhinum majus*	Antirrhinum ..	Stem.
Cucurbitaceae—		
Citrullus vulgaris	Water melon ..	Stem and fruit.
Cucumis cantalupensis ..	Rock melon ..	Stem and fruit.
Cucumis sativus	Cucumber	Stem and fruit.
Cucurbita pepo.	Pumpkin	Stem and fruit.
Cucurbita pepo. var. *Blighia sapida*	Marrow	Stem and fruit.

FIG. 1. TWO TYPES OF SCLEROTIA GROWING FROM LUPIN SEED.

FIG. 2. THE FUNGUS GROWING FROM SWEDE SEED

Table of Hosts and Parts affected.—continued.

Host.		Parts affected.
Botanical Name.	Common Name.	
Compositae—		
Circium arvense	Californian thistle ..	Stem.
Cnicus lanceolatus	Spear or Scotch thistle	Stem.
Helianthus tuberosum ..	Jerusalem artichoke	Tuber and stem.
Lactuca sativa	Lettuce	Crown and leaves.
Silybum marianum ..	Milk thistle.. ..	Stem.
Sonchus oleraceus	Sow thistle .	Stem.
Zinnia elegans	Zinnia	Inflorescence, stem.

Recently, when testing a commercial line of English swede seed for the presence of dry-rot (*Phoma lingam*) several greyish-white discoloured seeds were observed in the sample. These were planted on prune dextrose agar, and typical colonies of Sclerotinia sclerotiorum secured. This illustrates the manner in which the fungus has spread to the swede crops in the Dominion, where in recent years it has proved a troublesome disease.

DELAYED GERMINATION IN CEREALS.

ALTHOUGH the seeds of cereals are commonly regarded as being easy of germination, yet samples of wheat, oats, and barley are frequently found which do not give complete germination within the standard testing-period of twelve days. Almost invariably such samples are from newly harvested lines, and so far as New Zealand is concerned the trouble is confined almost wholly to oats and barley. This delay may be due to either heating in the stack or to incomplete maturity. A heated sample is, superficially, fairly obvious, but the failure to germinate of a clean well-stored grain has frequently caused much speculation.

Samples of newly threshed oats and barley were received last year which showed only a very low growth-percentage—frequently under 10 per cent. Yet if this seed was held for two to six weeks it gained the ability to germinate normally. The phenomenon is due to the fact that, although the seed is to all appearance ripe at the time of harvest, it is not what is termed "germinating ripe," and some time has to elapse before the after-ripening processes are completed. With special laboratory treatment, the after-ripening process in wheat and barley can be brought to completion in a few days, when the seed will germinate normally; but in the case of oats the samples have to dry out without assistance before a normal germination can be obtained. The field germination of such samples is usually very erratic—in some cases the growth percentage is higher than the artificial one, and in others very much lower, in some cases nil.

Care should be taken, therefore, in the sowing of newly harvested cereals, and if the laboratory growth is low the line should be stored under dry airy conditions for at least one month.

—*N. R. Foy, Seed Analyst, Plant Research Station.*

USE OF THE HYGROMETER IN CURING TOBACCO-LEAF.

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THE hygrometer, or wet and dry thermometer, can be of great assistance to the intelligent grower in the process of flue-barn curing of yellow tobacco-leaf. The use of a hygrometer is to ascertain the amount of moisture contained in the air. To understand the working of the instrument certain natural laws must be recognized: (1) In the process of evaporation or drying-up a certain amount of heat is consumed or used; (2) saturated air can hold no more moisture, therefore evaporation in an enclosed space ceases; (3) dry air absorbs moisture from wet objects more or less quickly, according to the temperature above freezing-point.

In order to test a hygrometer place both bulbs in cold water at 40° F., when they should read the same. Next place them in warm water at 100°, and then in hot water at 150°, when again each should read the same. If the instrument does not record exactly on both bulbs it is useless. Assuming the instrument to be correct, fill the sump with water and adjust the wick. Completely cover the mercury of the wet bulb. Expose the wet and dry bulb to the sunshine outside at, say, 85° on the dry bulb. By the time the water in the sump has reached the same heat the evaporation of moisture from the wick covering the wet bulb will be about 15° lower than the dry bulb; fifteen degrees of the sun's heat is being used to dry up the wick; the air is dry and able to absorb it.

Now for the adaptation of the hygrometer to the process of tobacco-curing. After the barn has been loaded with its correct quantity of ripe tobacco-leaf the hygrometer should be hung in a central spot among the leaves, where it can be easily examined, but not directly over the hot flue-pipe. The barn should be shut tight so as to hold all the moisture given off by the wilting leaves. The hygrometer reading, after the fire has been going about two hours and a temperatur of 80° has been reached, should be 80° dry and 77° wet, and this difference of three degrees should be kept throughout the whole of the yellowing process of thirty-six to fifty hours as the case may be.

When the hygrometer registers more than 4° F., difference between dry and wet bulbs it shows that the barn is drying out too quickly, as in the case of a leaky building, and artificial moisture must be added, such as wetting the walls and floor. Do not put water on the flue-pipes, as the steam formed is 212° at contact and is liable to scald the leaves as the steam rises into them.

For the tobacco to have turned yellow a certain quantity of moisture must have left the leaf, but the process is very slow, and the leaves have been more cooked yellow than dried out. During the period of fixing of colour, between 95° and 115°, the use of the record indicated on the hygrometer is most important to the curer. If the tobacco is dried out too quickly—say, with a difference of 15°—it will blotch, rupture the cells or fabric of the leaves, and go patchy brown. If, on the other hand, it is dried out too slowly and moisture allowed to settle

Flue-barn Chart for Curing of Yellow Leaf Tobacco.

Day.	Time.	Hours.	Temperature.	Remarks.
	p.m.		Degrees F.	
Monday ..	9		80	Ventilators shut tight.
	10		90	
	11		90	
	12		90	
	a.m.			
Tuesday ..	1	4	90	Hygrometer wet bulb 3° to 4° below dry
	2		90	
	3		90	
	4		90	
	5	8	90	
	6		90	
	7		90	
	8		90	
	9	12	90	
	10		90	
	11		90	
	12		90	
	p.m.			
	1	16	90	
	2		90	
	3		90	
	4		90	
	5	20	90	
	6		90	
	7		90	
	8		90	
	9	24	90	
	10		90	
	11		90	
	12		90	Form steam-water on flue.
	a.m.			
Wednesday ..	1	28	90	
	2		90	
	3		90	
	4		90	
	5	32	90	
	6		90	
	7		90	
	8		90	
	9	36	90	Leaf begins to yellow at tips and edges.
	10	37	91	
	11	38	92	
	12	39	94	
	p.m.			
	1	40	96	Yellow spreads to midrib.
	2	41	98	
	3	42	100	Leaf yellow.
	4	43	102	
	5	44	103	
	6	45	104	Wet bulb 6° to 7° below dry.
	7	46	105	
	8	47	105	
	9	48	110	Midrib yellow.
	10	49	110	Fix colour.
	11	50	110	Ventilator open 2 in
	12	51	110	

Flue-barn Chart for Curing of Yellow Leaf Tobacco—continued

Day.	Time.	Hours.	Temperature.	Remarks.
	a.m.		Degrees F.	
Thursday ..	1	52	115	Half open ventilators
	2	53	115	
	3	54	115	
	4	55	115	
	5	56	115	
	6	57	115	
	7	58	115	
	8	59	115	
	9	60	115	Full open ventilators Tips of leaf curl upwards.
	10	61	115	
	11	62	115	
	12	63	115	
	p.m.			
	1	64	115	
	2	65	115	
	3	66	120	
	4	67	120	Sides of leaf curl inwards.
	5	68	125	
	6	69	125	
	7	70	125	Blade of leaf should be dry.
	8	71	125	
	9	72	130	Remove hygrometer
	10	73	130	
	11	74	130	
	12	75	130	
	a.m.			
Friday ..	1	76	135	Veins of leaf should be dry.
	2	77	135	
	3	78	135	
	4	79	135	
	5	80	135	Reduce vents.
	6	81	140	
	7	82	145	Half vents.
	8	83	150	
	9	84	155	Almost close ventilators.
	10	85	160	
	11			
	12			
	p.m.			
	1	88		
	2			
	3			
	4			
	5	92	..	Midrib dry.
	6			
	7			
	8			
	9	96		
	10			
	11			
	12			
	a.m.			
Saturday ..	1	100	170	Stalks should be dry.
	2			
	3			
	4	104		

on the face of the leaf (this often happens in the corners) the leaf will sponge at a temperature of 105°, with the hygrometer showing a difference of only 3° below for the wet bulb. It should show a difference of 6° to 7° at that temperature, and the difference be continued right up to 115°.

After the blades of the leaf are dry at, say, seventy-two hours, at a temperature of 130°, the hygrometer should be taken out of the barn, as it is of no further use when killing out the leaf, and very often has been burst.

The accompanying chart has been used by many tobacco-growers. It should be borne in mind that the chart is adapted for a barn 16 ft. by 16 ft. by 20 ft. inside, filled with eight tiers of eighty-eight sticks, or about seven hundred sticks of first-picking ripe lower-leaf lugs. The times and temperatures must be varied as the season advances and leaves are gathered higher up. The top leaves picked, say, at the end of March when nights are comparatively cold, would need a longer time and lower temperatures for the first yellowing stage.

Consistent use of the hygrometer for recording the humidity of the tobacco-barn during the early stages of yellow-tobacco curing will give the grower a confidence in his work. It removes the danger of guess-work at a very critical period, especially in changeable showery weather when atmospheric conditions vary from wet to dry in the course of a few hours.

OCCURRENCE OF SUN-SCALD ON APPLES IN HAWKE'S BAY.

SEVERE sun-scald on apples occurred throughout the orchards in Hawke's Bay during a period of high temperatures and still air on the 23rd and 24th of January this year. During this period many heavily laden branches fell down suddenly where unsupported, allowing the hitherto shaded surfaces of fruits to become suddenly exposed to the sun. A noticeable feature of damage was the increase in severity on those horizontal branches nearer the ground, where the movement of the air was less, whereas higher in the trees and on uprights the damage was hardly appreciable. The damage was more general, and more severe in character in very sheltered situations, and decreased on trees which were more in the open. It appears that where there is air movement, even though moderate, sun-scald does not occur. Trees which were adequately braced and had fruiting arms supported suffered but slightly in comparison with others not protected in this way.

The bracing of fruit-trees and giving additional support to heavily laden branches is indicated as a method of minimizing fruit losses through sun-scald. The practice in itself is very desirable, as it provides protection against breakages and makes for the easier working of the orchard where large trees are involved. It becomes even more desirable when, by this practice, protection against sun-scald may be secured.

—*N. J. Adamson, Orchard Instructor, Hastings.*

Eradication of Chewings Fescue.—A Marton farmer writes to the Editor regarding a method successfully used by him for getting rid of Chewings fescue. He ploughs about October, burying the fescue with skim skeiths; then cultivates in the ordinary way, and sows rape or swedes in December. The fescue is found to be all rotted by the following spring and acts as manure. The main point is the use of the skim skeiths (coulters) in the ploughing when the fescue sward is first broken up.

SEASONAL NOTES.

THE FARM.

Reviewing the Feed Position.

As the first step to the making of plans for future work many farmers will find it very useful at this season to review their position in respect to feed. Generally the position will give rise to anxiety rather than to satisfaction. Because of the prevailing unfavourable season stocks of hay and silage are much lower than they would have been had the season been a normal one. This is reflected in the fact that hay is already being sought at prices exceptionally high relative to the current prices of farm produce. In addition, the unfavourable season also leaves the supplementary fodder-crop position less satisfactory than it usually is. It will probably prove advisable to consume in late summer reserves of feed, including silage, which normally would serve for the winter period.

Linked with this unfavourable feed position is generally a weakened financial standing, which naturally makes farmers anxious to spend every penny of outlay to the best advantage. It may be said with certainty that some, in their eagerness to exercise economy fully, are so drastically reducing expenditure as to be really practising harmful parsimony or false economy, which at times may prove very far-reaching and enduring in its undesirable influence. It is not always advisable to meet a period of low prices by indiscriminately drawing tight the purse-strings. Expenditure, indeed, provided it is judicious, is at times the essential accompaniment of efficiency. Phosphatic top-dressing, a matter of seasonable and vital importance, aptly illustrates this.

Autumn Top-dressing with Phosphates.

Of the several measures which may be employed to assist in relieving the position, top-dressing with phosphates, especially superphosphate and, in suitable districts, basic slag, well deserve pride of place. Two main facts relative to phosphatic top-dressing are sufficient to indicate what course should be taken. In the first place, over wide areas the profit from such top-dressing was so great, on the old scale of prices for farm-produce, that there still is an attractive profit in the returns at the present prices. Indeed, at times it is only by taking advantage of the profits available by means of phosphating that farming can be made to pay at all. In the second place, not only have recent years been marked by a swing in popular favour to the practice of autumn application of phosphates in contradistinction to spring application, but critical examination of the position has shown that this swing is essentially sound. Direct financial considerations may lead some to incline to spring top-dressing; spring application may mean escaping from the payment of about four months interest on the cost of the manure; it may mean that no payments for fertilizer have to be made until well on in the producing season, in which the greatest amount of benefit from the manure is obtained. These considerations may seem sufficient to justify spring top-dressing until they are weighed against the advantages which usually are attached to autumn top-dressing with phosphates.

Quite an important advantage of February to April top-dressing is that, prior to the dormant winter period, it usually brings about an appreciable increase in valuable growth. If the top-dressing is done at an early enough date, some of this increase may be particularly useful this year in maintaining dairy production towards the end of the season. Certainly in view of the prospective winter scarcity of feed, any additional

growth of the pastures in April and May this year will be especially welcome as a means of keeping the stock in good condition to face the severe late-winter spell that usually occurs.

Another important advantage of autumn top-dressing lies in the fact that while it stimulates growth in early spring practically to the same extent as would a similar amount of spring top-dressing, it is declining in the intensity of its influence by the time summer arrives, and so does not bring about such a rush of early summer growth as does spring top-dressing—a rush of growth which at times is so difficult to control effectively as to become an impediment to economical grass-farming.

Autumn top-dressing with phosphates may be summed up as the most important measure available for obviating the winter and early spring shortage of feed, which at the time of writing threatens so many, and which if not removed to a satisfactory extent will beget serious consequences in the next producing season.

In cases in which it proves impossible to completely top-dress farms in the autumn two classes of pasture should be singled out for priority in attention. Firstly, the better-class pastures, such as those containing a relatively large amount of rye-grass, should be dressed prior to inferior ones. The former, as a rule, have capacity for greater absolute response to top-dressing. This is suggested by the fact that a 20-per-cent. increase in growth of a good pasture has greater value than a 20-per-cent. increase of a relatively poor pasture. Secondly, young pastures should as a rule be given priority in a restricted top-dressing programme to older and possibly worn ones. This view is based on the belief that it is more economical to take proper care of the young pastures, and thereby to maintain them at the best possible standard, than later to have to face the difficult and costly task of repairing or renewing them.

Emergency Catch-cropping.

While top-dressing is the major matter in regard to which one should be careful not to allow false economy to replace true economy it may well be kept in mind, during current circumstances especially, that the work of growing special forage crops is one in respect to which the avoidance of expenditure may be unwise. Fortunately there is available a range of suitable forage crops which, sown in the late summer or early autumn, become available when during this year, and frequently in other years also, they may be critically needed.

Land having grown such crops as oats, wheat, maize, millet, soft turnips, or rape, may be ploughed immediately these crops are removed, and then sown without delay in temporary pasture, oats, or barley in the way described in these notes last month. If the land to be sown in such crops is so hard as to make satisfactory skim-ploughing impracticable, then cultivation with disks set with plenty of cut will frequently serve as a satisfactory alternative to the skim-ploughing. Such crops, and particularly the temporary pasture, should be sown with as little delay as possible.

In preparing the land for catch-crops it is not necessary to reduce the surface layer of soil to a fine condition. Indeed, the presence of small clods at times proves a distinct advantage. The clods prevent the caking of the surface which at times takes place in a fine surface layer of soil under beating rains, and eventually they are broken up by natural weathering. To stimulate rapid vigorous growth the forage crops mentioned above should be sown with liberal dressings of fertilizers in which superphosphate is prominent.

Utilization of Summer Feed.

Those who have practised ensilage are usually in a better position to face the critical late summer period than are those who have not. In the

first place, fields from which silage was saved at a suitably early date are likely to provide a substantial aftermath of green feed, which will prove particularly valuable, as in its characters it meets the specific needs of the season. In the second place, if necessary, silage saved during the current summer may be fed at this stage. Some who look upon their silage as a reserve of winter feed may be reluctant to feed it in the summer, but if the supply of summer feed is definitely inadequate the feeding in summer of silage intended for winter is normally well justified, particularly if it is from leafy growth. Under such conditions it will give handsome immediate returns, and there is always the possibility that it will not be so acutely needed in the winter, for even if the autumn is not particularly favourable, one may, between now and winter, have recourse to cropping here mentioned.

At times one sees maize and millet grown as green-feed crops kept too late. Frequently, rather than take the risk of having them become too woody or of having them cut down by frost, it is advisable to utilize them earlier and to employ the land thereby rendered vacant by growing one of the catch-crops mentioned. Any portion of maize or millet that cannot suitably be used as green feed should be conserved as silage, unless the amount available is so small as to make this course not worth while because of the high proportion of wastage accompanying a small lot of silage. When the amount available does not justify ensilage then it may be made into hay, and in doing this it is well to remember that it is usually somewhat difficult to dry to a safe condition the comparatively coarse stalks of these crops.

Lucerne Culture.

During March a cut of hay or green feed is commonly available from lucerne fields. After such a cut, if weeds are a menace, and dry conditions prevail it is likely to be advantageous to run over the crop with tine harrows, or other harrows fitted with teeth possessing the fine points necessary to avoid undue injury to the lucerne plants. Pertinent to this matter is the fact that more harm than good has at times been done to lucerne crops by inappropriate surface-cultivation. Cultivation may be considered unsuitable if because of its severity, or of the nature of the implements employed, it destroys an appreciable number of the lucerne plants. Hence the use of flat-toothed cultivators which cut the stems or main roots of the lucerne, proves inadvisable. If much cultivation is needed to rid lucerne of invading plants of grasses and clovers, then it may be sound practice to use the lucerne chiefly as a grazing area from which probably it will be possible to obtain not more than three cuts a year ; the total value of the grazing and these three cuts is likely to be greater than that of the yield of the thin crop of lucerne alone, and, further, the cost of cultivation is not incurred.

The Pastures.

Pasture establishment is another matter in respect to which some may be led into a course involving grievous false economy—grievous because if, on the score of outlay, a weakness is allowed to creep into a permanent pasture at its establishment, the annual influence of this weakness will be multiplied according to the life of the pasture. One of the matters that allows of a reduction of outlay, which, however, is linked with a much greater reduction in eventual efficiency, is the purchase of rye-grass seed. Commercial perennial rye-grass may broadly be divided into two classes—false perennial, much of which is on the market, and true perennial, which is on the market in limited quantities and at a much higher price. Field experience demonstrates that even at the higher prices it is real and substantial economy to use the true perennial type in the establishment of permanent pastures.

It is impossible by eye examination to discriminate with any assurance between seeds of the true and of the false perennial classes of rye-grass. But fortunately the careful purchaser is not without reliable guidance in the matter. He may use certified seed, which is sold in officially sealed sacks and which to the best knowledge of the Department of Agriculture consists of true perennial rye-grass. Purchase of certified seed forms the best available guarantee that true perennial rye-grass is being secured. Farmers unable to secure certified seed may with distinct advantage to themselves have samples of rye-grass lines which they contemplate purchasing submitted to the ultro-violet ray test by this Department. This test, which is carried out free of charge for farmers, enables good rye-grass to be distinguished, with accuracy sufficient for farmers' purposes, from inferior rye-grass.

At times farmers may be inclined to lower their outlay on pasture seed mixtures by reducing the amount of cocksfoot used. As a rule this is most undesirable. Frequently in the past the amount of cocksfoot used for permanent pasture has been too small. Almost universally in New Zealand—including land on which one should aim to build up a rye-grass and white clover dominant sward—cocksfoot is of outstanding value from December onwards in providing feed during the summer period in which rye-grass and other useful pasture species are making but scant growth. At times the tufty habit of cocksfoot has been accentuated by the small number of plants in the sward due to the use of less seed than could have been advantageously used. Generally the minimum amount of cocksfoot that should be used is 10 lb. an acre, and the amount rises to 15 lb. for conditions more suited to cocksfoot than to rye-grass—for example, dry conditions of the east coast of both Islands, apart from areas where rye-grass seed production may be a major consideration.

In the interests of true economy the purity and particularly the germination of all pasture seeds, including certified lines, should be ascertained. New Zealand cocksfoot and New Zealand white clover seed almost invariably give pasture plants markedly superior to those from imported seed. The matter of pasture seed mixtures was dealt with in some detail in these notes in August, 1931, and in February, 1931.

Topping of pastures as described in last month's notes may be advisable in March. As grass harrowing during a dry spell is seldom advisable, it will be good practice on many farms as soon as March rains occur to push ahead with harrowing, in order to distribute the droppings which have been allowed to accumulate during the dry conditions.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Spraying Operations.

In those districts where hatchings of codlin moth continue well into March it may be necessary to again apply an arsenate spray to all varieties that are as yet unpicked. The control of red mite should on no account be delayed, otherwise winter egg-laying will commence, thus making the task infinitely greater.

Cultivation, Irrigation, and Cover-cropping.

In many of the fruitgrowing areas March is a favourite month for sowing the orchard cover-crop. A good seed-bed is essential, and in most soils the working into the ground of a light dressing—say, 2 cwt. per acre—of super a little while prior to sowing will materially assist the crop. In dry areas, where water is available, much can be done in the autumn to prevent the spring die-back common in those localities, by judicious

irrigation to keep the soil in an evenly moist condition. In such areas the winters are dry, and the tree-roots if left dry in the autumn will remain so until the irrigation the following spring.

Faults to avoid in handling Export Fruit.

When a crop of high-grade fruit has been produced every effort should be made to place it either on the local or the overseas market in first-class order. Although speed is essential, it should not be the governing factor in any operation in orchard or packing-shed. With the experience now gained by the older growers and the assistance rendered by the Orchard Instructors to the less experienced, there should be little trouble in gauging the maturity at which to pick the fruit. Quite a lot of fruit has to be culled out and rejected through faulty work in the orchard. Inexperienced and rough pickers should be very closely supervised. A pulled out stalk, a finger-nail mark, stalk punctures caused when pouring the fruit into the cases, bruises by dropping fruit into the picking bag, bucket, or case, the exposed point of a nail or a projecting splinter of wood in the orchard boxes, warped timber in such boxes, and the overfilling of picking utensils and cases—all these help to swell the heap of fruit which is unfit to be marketed.

On no account should fruit be allowed to remain in the sun after being picked, and every effort should be made to cool down the fruit before packing. If the wagon or truck is too high, or too highly loaded, the cases of unpacked fruit cannot be handled with ease, and bruising often results. On the other hand, too low a conveyance is liable to make the fruit dusty. In the cartage of the fruit out of the orchard, which should be done in a well-sprung vehicle, some bruising can be avoided by filling up holes here and there and rough levelling of the surface over which the conveyance has to travel.

Where it is possible to allow the fruit to stand a day or so after picking before grading and packing the skin will harden considerably, and much surface-marking will be avoided. The Sturmer in particular is benefited by this treatment, as when newly picked it is liable to show every finger mark.

In the packing-shed there should be nothing but what is required for the business in hand. It should be laid out to give the maximum light, efficiency, and space for easy working. The handling here requires the same extreme care; the grader needs to be kept in good running-order, and frequently cleaned to get rid of the oily matter which, in combination with dust and other deposits from the spray on the fruit, sets into hard lumps. Overfilled bins are often a source of bruising and stalk puncture.

In packing, efficiency must not be subordinated to record breaking; the learner especially should learn to pack properly and to eliminate every superfluous movement before endeavouring to speed up. Pressure with the hands at the ends of the cases as the fruit is being packed, and the turning of the fruit in the right direction on the top layer, will help considerably to avoid injury when lidding. The cases must be well filled with a reasonably large bulge. The nailing-down man should remember that much depends on him in avoiding case-marks and bruising when placing on the lid and when nailing down. A badly driven nail often means trouble; if projecting inward a punctured fruit will often result; if outward probably someone's ripped hand and a dropped case.

Fault can at times be found even in the labelling. If a poor paste is used the case may reach its destination minus a label. Again, the stamping of the particulars on the labels often leaves much to be desired, and when such cases reach the overseas brokers' stores the marking is

hardly decipherable, being either faded out or blurred. In both these instances the identification marks of grower, variety, size, &c., have gone, and the grower wonders why his returns are short.

These are some of the "little" matters which influence the amount of cull fruit in an orchard, and which if given proper attention will go a long way towards keeping up the high reputation we have gained for our fruit.

Miscellaneous.

In Southern districts budding should be completed as soon as possible. Where frosts are not anticipated, and the stocks are still in good condition for working, the work may be carried out during March. Stocks already budded should be watched, and when the buds have "taken" the knife should be run through the tie on the opposite side of the stock to the buds, leaving it to be gradually pushed off.

In picking for local market as well as for export it is very unwise to be short-handed and allow the picking to get behind. If the work gets ahead of the grower and there is danger of his running one variety late all the time, it is often better to cut out temporarily a variety and get on to the next, so as to keep abreast of them as they mature.

—W. R. Lloyd Williams, Orchard Instructor, Alexandra.

Citrus Culture.

The continued dry weather being experienced is having a retarding effect upon the development of the trees, and very little can be done to assist them. However, it will be wise to carry out some cultural operations during the coming period. This will break the surface, which will more readily retain the showers that may fall. Dry weather, if prolonged, places an undue strain upon the trees at a time when the young fruit is developing, and every assistance should be given them to help withstand this strain.

Care should be taken, however, to prevent an undue amount of wood growth during the autumn, as it is in the winter following that a great deal of damage to immature shoots may occur. Any fertilizers that may be applied should not be of a highly nitrogenous nature, but consist mainly of phosphates and potash. An application of a slow-acting nitrate, such as blood and bone, would not force the wood growth and could be used with safety.

If trees have been making strong growth the pinching of shoots should not be neglected. Moreover, all old and worn-out portions of branches should be removed.

There will not be a great deal of picking to be done at this period of the year, but all lemons which have reached a good marketable size should be gathered, irrespective of whether they are yellow, silver, or green. No advantage is gained by leaving them on the trees, as the next season's crop is now being developed, and everything that will place undue strain upon the trees should be avoided.

If thrips are in evidence the trees should be sprayed with Black Leaf 40 at 1–800. This can be added to the bordeaux mixture when spraying for the control of verrucosis.

L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Culling the Flock.

EVEN under the normal conditions that existed a few years ago heavy culling had to be resorted to if really payable results were to be secured from the poultry business; but at the present time it is obvious that drastic culling is imperative if a reasonable profit is to be secured over

the cost of production. The coming month is the best period of the year in which to detect the weak hens and to choose the birds which will prove profitable for another season, also to select the birds for the breeding-pen—just before the hens show signs of taking a rest prior to moulting.

Ability to judge on form at this stage will prove a valuable asset, for by possessing the necessary keenness of eye to pick out the birds not constructed on egg-producing lines a poultry-keeper is in a position to weed out the drones, reduce the food bill, and thereby increase the profit from the payable layers. To those who do not possess a trained eye for laying-form the culling of the poor layers, even at this period of the year, may prove a matter of great difficulty.

The time of moulting gives a good indication of productive capacity. All things being equal as regards the time of hatching, feeding, and general management, it is usually the poorly constituted bird which goes into an early moult, and there is no place for the early moulter when poultry are being kept for profit. It is a good rule, therefore, to eliminate the early moulters, and this point cannot be emphasized too much. Drastic culling should take place of all birds that are on the point of terminating their second laying-season ; in fact, no hen of this age should be retained on the plant unless it is such a creditable member of a laying strain, and of such undoubted constitution, that it will pay to retain it for breeding purposes.

Many of the second-season layers will probably carry their old feathers right into April, and this fact will indicate even to the inexperienced eye that they will go on laying. Obviously such birds should not be culled until they give indications of taking a rest prior to moulting. Apart from early moulting as indicating the conclusion of the individual fowl's normal laying-period, the following points may be mentioned. Being overfat or above the normal weight of the breed are indications of weak constitution, as are also dull eyes, feathered face, sluggish appearance, and shrunken abdomen development to the extent that the point of the breast-bone comes in close contact with the pelvic bones, which also contract, in contrast to the bird which is in a condition to continue producing. The apparent shrinkage of the comb, with consequent disappearance of the bloom, is another sign that the bird is about to discontinue laying.

Not only should the second-season layers be heavily culled, but birds which are terminating their first laying-season should also be carefully gone through and any weak specimens eliminated. In the case of the first-year layers the culling may be light, but it should be remembered that it is unwise to retain any bird on the plant, quite irrespective of its age, which does not promise to return a good net profit.

In the work of culling it is important that the different ages of the birds be taken into consideration, particularly when the time of moulting is taken as the chief guide to productive capacity. For example, the first-season layers will usually moult before the second-season birds, especially if the latter were selected as late moulters at the conclusion of the first laying season. This indicates the necessity for having a distinguishing mark on all birds for age determination. Another matter which should be taken into account is that a sudden change of food, the supplying of inferior food, or failure to provide the food necessary for heavy egg-production, may suddenly force even a good layer into a premature moult. In such circumstances as referred to in the two latter cases, the early-moulting rule is of little value, especially to the ordinary poultry-keeper. I would emphasize the point that if none but payable stock are to be retained on the plant for future laying and breeding purposes, it is of vital importance that the best specimens should be selected and the drones

got rid of before the general moult sets in; the signs which indicate high or low laying-power do not manifest themselves after the moult has fully set in. Another advantage in culling the drones before the change of plumage takes place is that they can be marketed to better advantage. From a poulterer's point of view the bird in moult is difficult to dress and does not present an attractive appearance.

It would be a mistake to cull at the present time birds of any age that show signs of being in a laying condition. These signs consist in the bird having no indication of moulting, and possessing red combs and a fullness of the abdomen, which is soft to the touch, and which has an active business-like appearance. Such birds can be culled when they show indications of casting their feathers.

In regard to the management of the birds which are to be retained, some discretion must be exercised. The best of the late moulters which it is desired to retain for the breeding-pens next season should be kept by themselves, and an endeavour made to check their production by providing a light diet in which forcing food such as meat is eliminated. It is a mistake to force the selected prospective breeding-birds to the limit for high egg-production, as the heavy drain which this entails on the system will make a bird unfit to produce eggs with the strong germs so essential for getting stock of good constitution.

From now onwards those birds that are retaining their laying condition, and which it is intended to cull, should be given a heavy meat diet in order to secure every possible egg from them before they are disposed of. Through being subjected to highly forcing conditions it is possible that an old bird may become affected with ovarian disorders, such as protrusion of the oviduct, but trouble in this connection will be reduced to a minimum if the great bulk of the meat ration is fed separately and not included in the mash mixture.

In selecting breeding-specimens first consideration should be given to points which indicate the possession of constitutional vigour. It should always be remembered that the best layers and late moulters are not necessarily the best breeders, although it is true that the best breeder is always a late moulter. Something more is required. What should be aimed at is good size of body, laying type, and a type in which indications of utility and breed characteristics are blended with constitutional points. Regarding desired size, I may say that it is not the diminutive layer that is recommended, however well she may have laid, nor the exaggerated type evolved for the fancy show-pen, but the medium, modified type in which egg-producing power has been developed with little harm to breed characteristics and standard weight requirement. Such birds may not lay as many eggs as the smaller type, but usually they can be depended upon to produce larger eggs and to possess the necessary breeding qualifications for the maintenance of desirable characteristics in a strain over a period of years. Furthermore, both they and their progeny will return better prices when disposed of for table purposes.

No effort should be spared in securing the best possible specimens for future breeding purposes. Just as there is a type of bird specially suitable for table purposes, and which converts the bulk of its food into flesh, so also is there a type indicating by its appearance the power to convert food into heavy egg-production, as well as the power to reproduce progeny with desired laying-capacity. There are, of course, exceptions to every rule, and it does sometimes happen that a bird not conforming to a desired laying type will be a heavy producer, but it is rare that such stock can be depended upon for the building-up or for the maintenance of a uniform laying flock. —*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Requeening of Colonies.

ATTENTION must be given in the autumn to replacing queens which are found to cease breeding early in colonies in normal conditions with ample food. In all probability they are too old or have been injured in some way. In any case they require to be superseded as soon as possible by young queens. It is a good plan to rear as many queens as possible and have them cared for in nucleus colonies later to be introduced to full colonies where needed. It is in the spring that young queens reared in the autumn prove so valuable. Their laying-powers are at their best, consequently the colonies build up rapidly; moreover, there is less tendency for the bees to swarm.

Autumn Feeding.

In some districts after the main honey-flow is over a fair amount of nectar is gathered, sufficient to keep the bees breeding and for them to store a little surplus. However, where weather conditions are not favourable the colonies' needs may require to be supplemented in order to promote late breeding. Too often beekeepers are tempted to extract too close when making the final extraction; consequently the sudden curtailment in the food-supply checks breeding, and the colony goes into winter weak in young bees. The amount of stores in the hives is of paramount importance, and the first thought of the beekeeper in the autumn should be that of food-supply. There should be at least 30 lb. to 40 lb. of honey in each hive; and where there is this quantity or more and it appears to be diminishing rapidly the colonies should be additionally fed. It must be remembered that it is in the autumn that the beekeeper lays the foundation for his next season's crop; consequently he must concentrate on wintering his bees in the best condition possible.

Precautions against Robbing.

During the next month or so, with very little or no honey-flow, bees are likely to rob the weaker hives. Do not encourage this by exposing honey, combs, syrup, &c. Contract the entrance of the weaker hives, as this gives the inmates a better chance to protect themselves. All operations with the hives should be performed expeditiously, and if feeding is necessary carry out this operation late in the afternoon, and then with every precaution to keep the bees quiet. If robbing should start, all operations in the apiary had better cease. Contract the entrances to the hives being robbed, and throw wet grass or weeds loosely on the alighting-boards so as to prevent the entrance of the robbers. If robbing cannot be checked in this way it may be advisable to shift the affected colonies to another situation in the apiary.

Uniting Weak Colonies.

It is well to make a note of any weak colonies and any that are not doing well, as these are likely to succumb during the winter and early spring. It is by far the better plan to unite them with others rather than winter them, as they frequently become a prey to robbers, and are in that case a danger. A simple method of uniting may be practised by placing the weaker hive on top of a stronger one and placing a sheet of newspaper between the two hive-bodies. In the course of a few days the bees in the weaker hive will eat their way through the paper and unite peaceably with the bees in the stronger colony.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Club-root Control.

THE club-root fungus, *Plasmodiophora brassicae*, is frequently the cause of serious loss among garden crops of cabbage, turnips, and others of a similar kind. The roots become distorted, their functions disturbed, and the plants are starved. The fungus attacking the crop may originally be in the ground, or the trouble may be caused by setting out infected plants. It is most serious when the ground is inclined to be wet and acid, as these conditions favour the growth of the organism.

The remedy recommended to combat this serious disease has been to attend to drainage and make a liberal application of lime, but while improvement has been obtained in this way the results were frequently far from satisfactory. It is a matter of great congratulation that the Mycological Laboratory of the Plant Research Station, at Palmerston North, has carried out experiments and demonstrated that by attention to detail this remedy may be most efficient. The summary of the evidence and conclusions contained in the January number of the *Journal* demand careful study by market-gardeners and those growing vegetable crops, as what has proved a remedy for this trouble in field crops of rape and turnips can be applied with equal advantage to other crops of the kind. The experiments draw attention to the importance of the kind and quantity of lime used, the method and time of application, and the danger of destroying the good effects of the lime by drilling in the seed with a manure that is to any extent acid.

The trials prove that an amount equivalent to 1 oz. per square yard of burnt lime, freshly air-slaked, is most effective ; but it must be applied some time before sowing or planting, so that it may have time to complete its work. This interval should be at least three months, and preferably twelve months ; and it is important that the lime should be intimately mixed through the upper layers of the soil in which the roots grow. Finely ground carbonate of lime may be used at double the above rate stated, but it is somewhat less satisfactory. Smaller doses of burnt lime are sometimes effective, even so small as ½ oz. to the square yard, when properly applied and given time to act, but this appears to be a minimum dose.

The effect of applying freshly air-slaked burnt lime to the soil in an intimate manner is to counteract acidity, and is the natural and peculiar action of an alkaline or basic substance. Obviously this action would be discounted by drilling an acid manure with the seed ; for this reason superphosphate and even basic super, as well as many special mixtures, should not be used when this disease is present. The experiments demonstrate that the manure used should be of a strongly basic nature, such as basic slag or a mixture of equal weights of superphosphate and freshly slaked lime.

Vegetable Crops.

The onion crops demand consideration at this season. During the coming spring and summer these bulbs are scarce, unless obtained from overseas, and such types are unsuitable for use in salads. Mild white onions, so useful for this purpose, are not good keepers, but, by sowing them during the month of March and planting out in early spring, a good supply may be obtained when they are in demand, there being usually a considerable shortage at that time. They should be sown thinly on soil that is moderately rich, so that growth may be steady.

The main crop of keeping onions so largely grown in Canterbury is sown in spring in that comparatively dry locality, where there is little danger of fungus disease and good weather for harvesting in late autumn can generally be relied on. In milder and moister localities the danger from disease is greater, and the prospects of good harvest weather at that period

are not so good. For these reasons it is customary in the latter localities to sow the crop during the month of March for planting out in spring. This results in the bulbs being in a forward condition before the period when disease is more troublesome, and allows of early maturity during more favourable weather

Onion crops recently harvested should have the roots and tops well dried off and then be stored in such a manner that they will not heat. The small bags of open texture and slatted boxes used by shippers are interesting methods of doing this, also the old method of weaving bulbs on strings. But almost any method which admits air freely to all parts of the stack is suitable. The store must be clean and airy, dry and damp-proof, to secure the best results. Such conditions are also suited for the storage of ripe pumpkins that are so useful during winter and early spring.

Other hardy vegetables sown now for spring planting and cropping are cabbage, cauliflower, lettuce, and spinach. These crops are most popular in the milder districts. The tender type of lettuce grown is rather subject to fungus diseases during the winter, when the seedings are much exposed to cold wet conditions. Under such circumstances they are sometimes given the protection of a cold frame and sashlights, and the warm close atmosphere which is then often developed is about as injurious as the opposite extreme. Such crops under glass should be given plenty of air and grown as hardy as possible. When water is necessary it should be given in the morning of a warm day so that the foliage may be dry before evening.

On a moist soil rich in humus the popular celery crop is grown with least trouble. Its quality and appearance depend on the sticks being clean and well blanched. Where a variety of the excellent golden self-blanching type is grown this is a comparatively easy matter, even when six or eight rows are grown close together. These and other types may be blanched by placing boards of sufficient width on edge down beside each row or multiple row. In fact, any method which excludes the light, without pressing so closely as to interfere with the growth is effective. In dealing with very large areas the rows may be carefully moulded with soil from the alleys. This treatment is best given when the usual growth is almost completed. Trimming, water, liquid manure, or any other necessary attention should be given just before moulding up for blanching, which may take from three to six weeks to accomplish.

Shorthorn carrots, turnips, and other seedling crops sown last month will require prompt attention with the hoe in fine weather in order to prevent the competition of weeds.

A soil may be richly stored with plant-foods that are not available. There is nothing so important generally for making them available as humus—material formed by the decomposition of animal and vegetable matter. Apart from any good material it may contain, its action on the physical condition of the soil is indispensable to fertility. For this reason as soon as a plot is released from cropping it should be sown down in a green cover-crop, unless it is required immediately for another purpose. Economy demands that a cover crop at this season should be quick-growing and hardy. Among those of that class generally sown are oats, barley, vetches, horse-beans, or white mustard. When these crops commence to flower it may be taken as an indication that growth is about completed, and they should be turned under, as any delay will be not only a loss of time but of quality in the material.

Rhubarb is another crop which thrives in a soil where humus is abundant. Where this crop is to be planted the land should be trenched or subsoiled in the autumn and well stocked with this material. If a small dressing of superphosphate is then given, before planting in the spring, the results should be satisfactory.

Tomato Crops : Under Glass and Outside.

The tomato crop under glass will in most instances have been harvested, and the busy grower generally will be giving attention to other crops. The glasshouses will be neglected, the old vines wither on their supports, the land will dry out, and plant insects and fungus diseases will have an excellent opportunity of becoming thoroughly established. This would not so much matter if a good rotation of cropping could be arranged, but where it is customary to grow tomatoes year after year in the same house great cleanliness is necessary, or pests and diseases get a stronger hold each year. It is therefore necessary, for many reasons, to take immediate steps to carefully remove and burn the old tomato-vines and thoroughly clean the house by spraying or fumigation, as may be necessary. When that is done light cultivation should be given, and the land sown down in a cover-crop. This crop is generally of a hardy nature, and thrives best at this season with ample ventilation at all times.

The outside crop is now being harvested. The boxes should be well filled with fruit of even maturity. This may be done economically by clean picking at regular intervals. Great interest is now being taken in the preservation of juices and pulp, and the improvements being made in the methods may be expected to increase the demand for ripe fruit at the peak of the harvest when there has often been so much waste. By preserving the fruit and juice at lower temperatures the flavour, aroma, and other qualities are retained, which increase its value and will undoubtedly make it more popular.

When selecting plants for seed more attention should be given to constitution and cropping-capacity. Too much attention cannot be given in making this selection, and the seed from each plant should be kept separate so that the type eventually will be as uniform as possible.

Berry Fruits.

Where new plantations are to be made it is well to remember that the success of the crop depends very much on how this is done. The fibrous roots of these plants lie very close to the surface, and only shallow cultivation can be done when once they are established. For this reason the subsoil should generally be well broken up and fertility deepened by turning in plenty of humus. Specially important is it that all twitches and bad weeds should be entirely eradicated ; to plant out on land where there is any doubt in this respect is definitely unwise and should not be done. In such a case the land should be devoted to annual crops, which will allow the cleaning process to continue.

Where well-cured farm manure is not available in sufficient quantities, established plantations of bush fruits should be sown down now with a good cover-crop that may be turned in early and so maintain the supply of humus. This is most important where the land is light and such materials are rapidly consumed. It is generally advisable to make an application of phosphatic manures before sowing this crop. It should not be necessary to state that these operations must only be done when the land is dry and friable, but there are many who repeatedly break this important rule in agriculture ; where the land is heavy the result of such a breach is deplorable.

The Homestead Garden.

Bright colours in the home garden are very arresting, but not less pleasing to many are the plants of curious and uncommon form that are so useful when interspersed among either a shrubbery which may appear a little dull or a bright patch of bloom that may be otherwise monotonous. In either case they give remarkable character to the picture, and for that reason are very valuable and demand the careful consideration of those who are planning to plant.

Among our native plants we have many very suitable for this purpose. So long as the land is of fairly good quality no position is too exposed for the cabbage-tree, tikauka, to flourish—even in localities somewhat dry. Of course, some can see no beauty in common things, especially when they are abused as this plant is so often , but the garden artist who places the cabbage-tree or a group or row of them in the picture with careful consideration will reveal great beauty in this tree lily with fragrant flowers.

In the same class, but more particular regarding environment, are the tree-ferns and nikau palms, which demand shelter from winds, and ground that is always moist. Localities with a rainfall of 36 in. per annum and upwards can usually provide this ; there they may be used with confidence, and, if they are skilfully placed, with great effect. The black tree-fern, mamaku, *Cyathea medullaris*, is the favourite, but the silver species, *C. dealbata*, does well where more shade is available. In the colder districts the hard tree-ferns, *Dicksonias*, should be planted. These are unsuitable for planting in new gardens, but may be placed in position when shelter is established. Many of the older gardens could be improved by such additions.

Among shrubs and trees of this class there is the very hardy puheritaiko, *Senecio rotundifolius*, and the more tender pukanui, *Meryta Sinclarii*, with very large leaves. The lancewood, horoeka, *Pseudopanax crassifolium*, with its well known unique character ; and for the North and warmer districts in the South the puriri, *Vitex lucens*, with its highly embossed leaves and cherry-like fruit.

Beside the water, our flax varieties, harakeke, should have a place, and toetoe, *Arundo conspicua*, which raises its plumes in midsummer. There are small ferns for every spot that is shaded and sheltered ; and many homesteads in high country are ideally situated for growing our native alpine herbaceous plants. Planted with a suitable selection from this and other lists recently published the homestead gardens will be not merely beautiful and comfortable, but of great interest, and they will effectually preserve what has often been called the incomparable flora of New Zealand.

—*W. C. Hyde, Horticulturist, Wellington.*

REVIEW.

Wool Quality : A study of the Influence of Various Contributing Factors, their Significance and the Technique of their Measurement. By S. G. Barker, Ph.D., Director of Research, Wool Industries Research Association. H.M. Stationery Office, London, 1931. Price 21s.

A GRANT from the Empire Marketing Board has made it possible for members of the staff of the Wool Industries Research Association in Britain to carry out a considerable amount of work in order that a more definite meaning might be given to the word " quality " relative to wool. The past and present rather haphazard use of this word in the wool trade is cogently summed up in the first paragraph of the book under review in the following words : " The exact definition of the term ' quality ' as applied to wool has proved to be an enigma which has defied precise solution from time immemorial."

The book is confined in the main to a study of those aspects of quality which affect the wool-sorter's estimation of the spinning properties of a wool, and a highly technical subject has been so treated that it makes attractive reading for those who are deeply interested in the subject. The

author has attempted to summarize not only the results of the work of his co-workers, but also that of most other workers whose endeavour it is to measure the various attributes of wool and to improve its manufacturing performance. Therefore, a good deal of the material in the book is not new, but has been summarized and brought together under one cover.

The subject-matter is well arranged in general so as to give a continuity to the reading, but since reference is made to wool-sorting in the first section dealing with wool-classing, the two might well have been grouped together rather than separated by a fairly large section dealing with wool-grease. This latter section deals fully with the importance of the grease, both to the fleece and to the manufacturer.

The most important section in the book is probably that dealing with the techniques used for measuring the various attributes of the wool fibre, and the history of these methods. Particular reference is made to the work carried out in the Research Association's laboratories, which has shown that there is a definite mathematical relationship between the fibre fineness of the various qualities of wool-tops, and it is pointed out that this should form a basis for an international agreement on standards for the various grades of wool.

Further sections deal fully with other fibre characters, such as crimp, contour, length, &c., the chemical and physical constitution and the structure of the wool, and a number of defects which limit the spinning-qualities of the fibre. In this latter section reference is made to the improvement which has been made in branding-fluids, and the attempts which are being made to introduce new and better types of wool-packs. In the summary it is admitted that, although much has been learnt in recent years about the various properties of the wool fibre, there is still much to learn before a full and concise answer can be given to the question, "What is wool quality?"

With due respect to Dr. Barker and his colleagues, exception must be taken to the statement on page 270 that the defect of weak or rotten wool "appears to be confined to New Zealand." Only one of many types of weak wool is referred to—*i.e.*, that due to bacterial breakdown of the wool fibre—and to say that it is confined to New Zealand is erroneous. A similar defect was reported from Australia some time ago, and is present most likely in the clips of most wool-producing countries, though as yet not specifically identified.

The bibliography contains reference to over six hundred publications bearing on the subject, but even then it cannot be said to be exhaustive, since among other points no reference is made to Sutton's work on wool-grease, although several pages of the book are devoted to this aspect of the work.

The book is clearly printed on good paper, and is well illustrated by good photographs, drawings, figures, and tables which serve to demonstrate clearly the points made. It forms a very useful addition to the literature of wool, bringing together as it does under one cover most of the present-day technical knowledge of the subject. This is particularly valuable in the case of research workers and teachers overseas, where it is often difficult to obtain copies of articles published in other countries. The book should prove useful also to managers of woollen mills, since it deals with the effects of recent research on certain phases of manufacture. At the same time it might quite well find a place as a work of reference in the libraries of those secondary schools and colleges where wool is studied as part of an agricultural course.

D. J. S.

WEATHER RECORDS: JANUARY, 1932.

Dominion Meteorological Office.

JANUARY proved to be a less pleasant month than the preceding two. It was remarkable for the persistence of strong westerly or north-westerly winds, Auckland Province being the only portion of the country to escape them. Temperatures were low for January, December having been a warmer month at many places.

Rainfall.—In the North Island the rainfall was much below the average. In the eastern districts of the South Island, too, there was a deficit which, though at most places not large, was especially detrimental owing to dry conditions having existed for many months previously. Frequent showers were experienced in Otago, except for the extreme northern portion. On the whole of the west coast of the South Island the rains were heavy. Indeed, the complaint there was of too much rather than too little precipitation. In Nelson and Marlborough, also, there were good rains. In the greater part of the North Island the rain amounted only to about half the average. Parts of the west coast, the Bay of Plenty, and also Whangarei experienced more normal conditions. In western districts of the South Island, and most of Otago, the experience was the reverse of that in the North Island, some places receiving almost double the average fall for January. From Hanmer Springs southward to Oamaru and its back country, the total was less than the average, and much of the rain was too light to be of much benefit.

Temperatures.—Though eastern districts experienced many warm days while the north-west winds were blowing, changes were frequent and the nights were generally cool. The mean temperature was between 3° and 4° F. below the normal for January in places exposed directly to the westerly winds. East of the ranges the departures were much smaller. Frosts occurred in parts of the South Island on the 2nd, and some damage was done to tender crops. A second frost, on the 31st, was rather more severe, and extended to parts of the North Island.

Winds.—The prevalence of north-west or westerly winds has already been mentioned. In the Taranaki Bight and Wellington Province, generally, those of the 3rd and the 26th were the most severe, some damage being done. The desiccating nature of the westerly winds accentuated the effects of the drought in the eastern districts.

Storm Systems.—The weather generally was of the type characteristic of spring rather than summer. Westerly depressions moved from Australia with unusual speed and regularity. Most weeks saw the advent of two of them, the total for the month being ten. Several were deep to the southward, but their northward extensions were generally poorly developed. The second of the depressions was a complicated one, the weather remaining unsettled from the 2nd to the 5th. The greater part of the Dominion received moderate to heavy rain during this period.

On the 9th a cyclone developed on the east coast of Australia and passed to the southward of New Zealand next day. It brought heavy rains to Taranaki and the western half of the South Island.

This storm was followed during the 14th to 16th by one which, unlike the others experienced during the month, had a good northward extension. A centre developed in this northern portion, and heavy rains were recorded over practically the whole of the North Island. In the north-central portion, especially, the falls were very heavy.

The last storm of moment passed on the 28th and 29th, when rain was again widespread. The heaviest falls were in western districts.

RAINFALL FOR JANUARY, 1932, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.
	North Island.				
		Inches.		Inches.	Inches.
1	Kaitaia	2·03	8	0·97	4·36
2	Russell	1·94	7	0·50	3·48
3	Whangarei	4·31	8	2·02	3·84
4	Auckland	1·14	7	0·30	2·61
5	Hamilton	1·97	9	1·09	3·70
6	Rotorua	2·83	6	2·16	4·04
7	Kawhia	3·31	8	1·08	3·24
8	New Plymouth	3·45	10	1·01	4·25
9	Riversdale, Inglewood ..	5·33	12	1·38	7·36
10	Whangamomona	3·73	5	1·32	5·33
11	Eltham	2·32	7	0·75	3·47
12	Tairua	2·08	8	0·84	3·87
13	Tauranga	1·20	5	0·50	4·11
14	Maraehako Station, Opotiki	3·65	7	2·60	3·70
15	Gisborne	1·29	8	0·37	2·77
16	Taupo	2·05	6	1·41	3·36
17	Napier	0·44	7	0·27	3·02
18	Hastings	1·12	7	0·55	1·99
19	Taihape	1·33	9	0·50	3·13
20	Masterton	1·49	8	0·82	2·55
21	Patea	2·67	8	0·75	3·46
22	Wanganui	1·70	7	0·79	2·79
23	Foxton	0·94	4	0·58	2·09
24	Wellington	2·16	11	0·82	2·81
	South Island.				
25	Westport	11·52	19	3·52	8·20
26	Greymouth	9·74	18	3·78	9·27
27	Hokitika	19·59	21	5·47	9·82
28	Ross	19·66	15	4·34	11·59
29	Arthur's Pass	15·48	13	2·82	10·66
30	Okuru	19·12	19	3·03	12·26
31	Collingwood	8·64	10	1·96	6·28
32	Nelson	3·39	8	1·34	2·74
33	Spring Creek	2·26	8	0·75	2·07
35	Hanmer Springs	3·00	11	0·97	3·55
36	Highfield, Waiau	..	..	..	2·96
37	Gore Bay	1·32	8	0·40	2·41
38	Christchurch	0·86	13	0·31	2·17
39	Timaru	2·12	15	0·44	2·17
40	Lambrook Station, Fairlie ..	2·01	12	0·31	2·34
41	Benmore Station, Clearburn	2·78	15	0·67	2·66
42	Oamaru	1·77	18	0·33	2·04
43	Queenstown	4·03	16	0·78	2·75
44	Clyde	2·84	12	0·94	1·77
45	Dunedin	3·92	18	0·85	3·33
46	Wendon	2·80	14	0·50	3·15
47	Gore	..	..	..	3·08
48	Invercargill	5·84	21	0·75	3·93
49	Puysegur Point	10·64	26	1·14	7·10
50	Half-moon Bay	6·22	21	0·97	4·34

Orange-tree killed by Milk.—The Orchard Instructor, Gisborne, reports that a ten-year-old orange-tree at Patutahi died recently as a result of skim-milk having been thrown around its trunk.

PERENNIAL RYE-GRASS SEED CERTIFICATION.

LIST OF GROWERS, SEASON 1931-32.

FOLLOWING is a list of growers who have had areas of perennial rye-grass seed inspected and passed in the field, in connection with the Government system of Seed Certification, for the season 1931-32 :—

Name.	Address.	Name.	Address.
Poverty Bay.		*Poverty Bay*—ctd.	
Allen, W. ..	Matawhero.	Jones, G. ..	Waerengaahika.
Alley, A. J. M. ..	Manutuke.	Jones, T. R. ..	Ormond.
Anderson, J. ..	Waerengaahika.	Judd, A. J. ..	Patutahi.
Atkins, J. ..	Patutahi.	Judd, A.R. and C. P.	Patutahi.
Atkins, W. ..	Patutahi.	Kane, T. ..	Matawhero.
Baillie, T. ..	Waimate Valley.	Kent, H. ..	Makaraka.
Baird, W. ..	Waerengaahika.	Knight, L. A. ..	Repongaere.
Barber, W. E. ..	Hexton.	Lange, H. D. C. ..	Matawhero.
Barr, J. P. ..	Te Karaka.	Lawless, D. ..	Manutuke.
Bell, H. ..	Hexton.	Linklater, J. ..	Waerengaahika.
Black, E. R. ..	Manutuke.	Lynn, T. ..	Manutuke.
Bolitho, N. G. ..	Waerengaahika.	Miller, R. C. and H. R.	Ormond.
Boyd, J. ..	Manutuke.		
Briant, S. D. ..	Patutahi.	Mills, D. ..	Makauri.
Brown Bros. ..	Waerengaahika.	Moore, H. ..	Makaraka.
Brown, J. B. ..	Waerengaahika.	Moore, R. H. ..	Waerengaahika.
Bull, W. C. ..	Te Karaka.	Mortleman, A. ..	Makauri.
Butler, P. ..	Patutahi.	Mullan, B. P. ..	Waerengaahika.
Cameron, A. J., Estate	Waerengaahika.	McIntosh, A. ..	Patutahi.
		O'Grady, D. ..	Makauri.
Cameron, R. ..	Patutahi.	Paku, O. ..	Whakaki.
Campbell Bros. ..	Hexton.	Paulson, A E. ..	Waerengaahika.
Candy, A. E. ..	Waerengaahika.	Peakman, W. ..	Whakaki.
Carroll, A. T. ..	Wairoa.	Pilmer, W. C. ..	Makaraka.
Carroll and Cooper	Patutahi.	Read, F. ..	Makauri.
Clark, W. ..	Opou.	Reeve, E. A. ..	Hexton.
Cooper, H. ..	Patutahi.	Roche, J. ..	Hexton.
Daulton, J. E. ..	Manutuke.	Rogers, J. J. ..	Makauri.
Davies, J. ..	Ormond.	Russell, J., Estate	R.M.D., Gisborne.
Duncan, A. ..	Waerengaahika.	Scott, Mrs. C. ..	Makauri.
Dunstan, T. J. ..	Matawhero.	Scott, G. ..	Waipaoa.
Fenton, R. G. ..	Waerengaahika.	Scott, R. ..	Puha.
Fisken, R. C. ..	Matawhero.	Sherriff, A. E. ..	Ormond.
Frazer, E. W. ..	Waerengaahika.	Smith, G. V. ..	Patutahi.
Frazer, T. ..	Whangara.	Smith, W. W. ..	Bushmere.
Gibson, C. ..	Matawhero.	Staples, W. ..	Makauri.
Gordon Bros. ..	Mangapapa.	Stevens, A. E. ..	Patutahi.
Gray, C., Estate ..	Hexton.	Stuart, F. ..	Patutahi.
Gray, S. T. ..	Hexton.	Symes, H. ..	Nuhaka.
Habgood, F. ..	Patutahi.	Taylor, J. ..	Ormond.
Hair Bros. ..	Patutahi.	Teitjen, C. ..	Waerengaahika.
Hansen, R. ..	Hexton.	Tombleson, T. W. G.	Nuhaka.
Haraki, W. ..	Whakaki.	Torrie, J. ..	Waerengaahika.
Hills, M. P. ..	Ngatapa.	Tullock, H. R. ..	Te Karaka.
Holden, T. ..	Hexton.	Turner, J. ..	Makauri.
Huka, I. ..	Whakaki.	Waiherere Incorporation	Gisborne.
Hunt, J. ..	Hexton.		
Irwin, F. A. ..	Patutahi	Whitlock, J. ..	Makauri.
Jackson, W. G. ..	Waerengaahika.	Williams, H. C. ..	Muriwai.
Jobson, W., Estate	Manutuke.	Wilson, G. ..	Bushmere.
Johnstone, J. G.	Waiherere.	Witters, G. ..	Hexton.

LIST OF GROWERS—*continued.*

Name.	Address.	Name.	Address.
Hawke's Bay.		*Hawke's Bay*—ctd.	
Agnew, J. ..	Mangateretere.	Holden, L. S. ..	Mangateretere.
Alexander, J. ..	Puketapu.	Holmes, P. C. ..	Whakatu.
Allen, A. W. ..	Tomoana.	Horner, V. T. L...	Waipukurau.
Allom, G. S. ..	Havelock North.	Houston, C. ..	Hastings.
Anderson, C. ..	Mangateretere.	Hunt, A. ..	Taradale.
Anderson, E. H.	Whakatu.	Joll, V. H. ..	Pakipaki.
Apperley, H. G ..	Hastings.	Jones, H. G. ..	Mahora.
Ashworth and Gavin	Pakowhai.	Jones, H. ..	Pakowhai.
Avison, O. D. ..	Haumoana.	Kenderdine, J. A.	Otane.
Baird, A. J. ..	Raupare.	Klingender, G. W.	Meeanee.
Beatson, G. D. ..	Hastings.	Knowles, W. C. ..	Pakowhai.
Beattie, J. ..	Twyford.	Kyle, T. ..	Raureka.
Bolt, Mrs. M. K...	Hastings.	Lane, M. ..	Te Awanga.
Bone, C. ..	Hastings.	Langdon, W. H.	Haumoana.
Boyle, D. J. ..	Pukahu.	Lascelles, P. W. ..	Mangateretere.
Bridgman, J. ..	Mahora.	Lister, H. H. ..	Clive.
Bridgman, S. G. ..	Haumoana.	Lloyd, J. ..	Clive.
Bridgman, T. ..	Mahora.	Lloyd, J. H. ..	Mangateretere.
Burge, A. J. ..	Twyford.	Logan, J. F. ..	Waipawa.
Burge, F. ..	Twyford.	Logan, W. ..	Otane.
Burgess, T. ..	Meeanee.	Loughnan, C. A.	Otane.
Burns, H. H. ..	Twyford.	Manson, A. ..	Twyford.
Burns, W. F. M...	Hastings.	Mardon, H. ..	Mahora.
Byford, W. J. ..	Haumoana.	Marshall, Mrs. E. M.	Hastings.
Carlyon, — ..	Poukawa.	Masters, A. J. ..	Twyford.
Clark, H. R. ..	Waiohika.	Masters, L. ..	Twyford.
Couper, E. D. ..	Havelock North.	Merrikin, G. ..	Hatuma.
Cranko, D. ..	Mangateretere.	Morrin, T. V. ..	Hastings.
Crawford, H. ..	Havelock North.	Murphy, P. B. ..	Mahora.
Currie, D. ..	Twyford.	Murphy, Mrs. P. B.	Mahora.
Currie, T., sen. ..	Twyford.	McCool, J. ..	Mangateretere.
Donnelly, W. H. C.	Pukahu.	McCutcheon Bros.	Fernhill.
Drummond, P. ..	Puketapu.	Macdonald Bros.	Havelock North.
Elliott, D. H. ..	Haumoana.	Macdonald, J. ..	Meeanee.
Emmerson, T. ..	Raureka.	McGaffin, A. ..	Elsthorpe.
Evans, F. E. ..	Twyford.	Mackay, A. C. ..	Mahora.
Evans, H. S. ..	Pukahu.	McKeesick, H. J.	Haumoana.
Fernie, D. ..	Pakowhai.	McKeown, G. ..	Mangateretere.
Field Bros. ..	Waimarama.	McLean, A. ..	Twyford.
Field, G. C. ..	Waimarama.	McLeod, D. E. ..	Raupare.
Freeman, S. ..	Haumoana.	McLeod, D. E. ..	Fernhill.
Frogley, R. ..	Mangateretere.	McLeod, H. ..	Raupare.
Gilbertson, H. R.	Havelock North.	McLeod, W. ..	Pakipaki.
Gillies, J. ..	Tomoana.	McLernon, P. ..	Mahora.
Glazebrook, H. M.	Maraekakaho.	McNab, J. A., sen.	Twyford.
Goodrick, C. F. ..	Mangateretere.	McNab, J. A., jun.	Twyford.
Gregory, R. ..	Clive.	McRobbie, I. W.	Waimarama.
Griffiths, R. ..	Twyford.	McRobbie, J. A.	Havelock North.
Guthrie, T. ..	Clive.	Neagle, P. P. ..	Meeanee.
Haldane, C. ..	Hastings.	Nelson, E. M. ..	Mangateretere.
Hardy, G. F. ..	Pukahu.	Nicholl, P. G. ..	Twyford.
Harris, J. H. ..	Hastings.	Nimon, Mrs. E. ..	Havelock North.
Harris, L. E. ..	Clive.	O'Neill's Estate ..	Mahora.
Heard, F. T. ..	Hastings.	Orbell, A. ..	Clive.
Heeney, Mrs. M.	Mahora.	Otene, B. ..	Tomoana.
Heeney, T. P. ..	Mahora.	Otene L. ..	Tomoana.
Herbert, H. L. ..	Mahora.	Otene,, T. ..	Tomoana.
Heynes, W. ..	Clive.	Panapa, T. ..	Tomoana.
Hill, A. E. ..	Mahora.	Parsons, P. ..	Meeanee.

LIST OF GROWERS—*continued.*

Name.	Address.	Name.	Address.
Hawke's Bay—ctd.		*North Auckland.*	
Person's Estate ..	Fernhill.	Stevens, K. M. ..	Maungatapere.
Pickering and Hackett	Waiohika.		
		Auckland.	
Pimley, F. ..	Mahora.	Smyth, R. C. ..	Te Kauwhata.
Potter, Mrs. O. ..	Fernhill.		
Potter, W. ..	Fernhill.	*Wanganui.*	
Price, Little, and Wilson	Puketapu.	Birch, A. C. ..	Marton.
		Manawatu.	
Ramsay Bros. ..	Haumoana.	Bailey's Estate ..	Sanson.
Rathie, J. J. ..	Clive.	Buchanan, A. R.	Kairanga.
Ryan, T. ..	Elsthorpe.	Buchanan, R. H.	Feilding.
Satherley, F. ..	Havelock North.	Callesen, J. ..	Longburn.
Simson, I. L. ..	Tomoana.	Campbell, N. ..	Awahuri.
Sinclair, A. ..	Mahora.	Fagan, H. J. ..	Sanson.
Skudder, A. ..	Mangateretere.	Henson, W. H. ..	Feilding.
Small, C. E. ..	Hastings.	Parsons, S ..	Kairanga.
Smith, A. H. ..	Poukawa.	Perrett, J. ..	Sanson.
Smith, E. ..	Twyford.	Reid, D. W. ..	Feilding.
Smith, F. R. ..	Raupare.	Wilson, G. H. ..	Bulls.
Speers, A. ..	Pakipaki.	Young, J. ..	Awahuri.
Starnes, Mrs. M. A.	Haumoana.	Young, W. J. ..	Kairanga.
Stead, W. G. ..	Raupare.		
Stevenson, W. G.	Havelock North.		
Struthers, A. ..	Longlands.	*Wairarapa.*	
Struthers, J. ..	Pukahu.	Percy, A. J., Estate	Masterton.
Struthers, W. ..	Raureka.	Yule, G. E. ..	Featherston.
Sweeney, L. ..	Mahora.		
Symes, A. F. M.	Longlands.	*Marlborough.*	
Tait, T. ..	Twyford.	Berryman, H. ..	Ward.
Tattersall, C. E. ..	Pakowai.	Blick, A. ..	Blenheim.
Taylor, H. ..	Pukahu.	Goulter, C. P. ..	Seddon.
Taylor, J. ..	Havelock North.	Moore, T. A. ..	Havelock.
Taylor, W. ..	Havelock North.	Neal, J. F. ..	Seddon.
Thompson, C. H.	Twyford.	Nees, C. ..	Okaramio.
Thompson, D. P. H.	Twyford.	Nicolas, J. T. ..	Ward.
Thompson, J. B...	Mahora.	Smith, E. ..	Spring Creek.
Thompson, J. H. and G.	Mangateretere.		
		North Canterbury.	
Thompson, T. J.	Pakowhai.	Bailey, P. V. ..	Springston.
Thompson, W. P., Estate	Pakipaki.	Bishop, R. G. ..	Southbridge.
		Boag, J. ..	Brookside.
Tiffen, D. N. ..	Otane.	Brookes, J. ..	Brookside.
Tod, R. H. ..	Otane.	Chamberlain, R.	Ellesmere.
Trotter, R. ..	Hastings.	Cross, A. E. ..	Bennetts.
Tucker, R. M. H.	Waiohika.	Cunningham, W. B.	Brookside.
Tucker, W. ..	Whakatu.	Forbes, G. W. ..	Cheviot.
Vance, Mrs. L. J.	Havelock North.	Galpin, H. ..	Southbridge.
Wake, A. E. ..	Pukahu.	Greenwood, A. C.	Southbridge.
Wake, B. ..	Karamu.	Grigg, G. H. ..	Horarata.
Wall, E. ..	Mahora.	Harrison, G. H. ..	Cheviot.
Wall, W. J. ..	Hastings.	Heslop, J. ..	Brookside.
Wattie, W. J. ..	Mahora.	Lill, D. ..	Brookside.
Wellwood, M., Estate	Hastings.	Marshall, D. ..	Springston.
		Morgan, T. C. ..	Tai Tapu.
Wellwood, R. A...	Mahora.	McGregor, D. ..	Ellesmere.
White, W. J. ..	Pakowhai.	Nairn, G. ..	Lakeside.
Williams, H. B. ..	Pukahu.	Nutt, H. ..	Motukarara.
Wilson, F. H. ..	Eskdale.	Powell, C N. ..	Springston.
Young, J. A. ..	Haumoana.	Russell, J. ..	Omihi.
Yule, D. C. ..	Mahora.	Skurr, K. ..	Dunsandel.

LIST OF GROWERS—*continued.*

Name.	Address.	Name.	Address.
N. Canterbury—ctd.		*Otago*—continued.	
Smith, T. J. ..	Oxford.	Jenkins, D. ..	Kelso.
Stevenson, J. ..	Flaxton.	Jones, J. ..	Clifton.
Stevenson, J. B. ..	Spotswood.	Murney, E. H. ..	Tapanui.
Stevenson, T. ..	Spotswood.	McRae, J D. ..	Waitahuna.
Thwaites, W. ..	Hororata.	Pullar, J. G. ..	Crookston.
Walker, J. ..	Dunsandel.	Sim, S. ..	Heriot.
Williams, C. M. ..	Kaiapoi.	Sutherland, W. ..	Clinton.
Wyllie Estate ..	Southbridge.		
		Southland.	
Mid-Canterbury.		Ayton, Mrs. I. B.	Otautau.
Doak, A. ..	Barrhill.	Barron, W. ..	Morton Mains.
Jones, C. H. ..	Winchmore.	Blue, A. ..	Balfour.
McDonald Bros. ..	Methven.	Brown, T. ..	Otautau.
MacKay, T., Estate	Willowby.	Burgess, H. A. ..	Invercargill.
Nicoll, E. F. ..	Ashburton.	Carter, G. H. ..	Mandeville.
Rutherford, T. ..	Springburn.	Clark, G. ..	Pyramid.
Tilson, W. R. ..	Hinds.	Couser, W. ..	Mataura Il.
Wilkinson, H. R.	Chertsey.	Cowie, H. ..	Otapiri R.D.
		Cowie, W. J. ..	Otapiri R D.
South Canterbury.		Forbes, J. ..	Waimumu.
Anderson, J. ..	St. Andrew's.	Fowler, W. ..	Winton
Brodie, R. ..	Rangitata.	Haigh, J. R. ..	Waipango.
Campbell, R. and P.	Kingsdown.	Hardiman, P. ..	Pyramid.
Gardiner Bros. ..	Temuka.	Hishon, W. P. ..	Oreti.
Hammond, R. ..	Fairview.	Holmes, F. ..	Riverton.
Hide, T. E. ..	Seadown.	Kelly, N. ..	North Chatton.
Medlicott, S. ..	Waimate.	Morgan, T. A. ..	Limehills.
Mee, J. P. D. ..	Levels.	Mortimer, W., jun.	Waipounamu.
Milne, J. H. ..	Waimate.	McCully, W. D. ..	Scott's Gap.
McKenzie, H. ..	Waimate.	Macdonald, J. ..	Gore.
O'Hara, J. C. ..	Glenavy.	Mackay, A. ..	Wendon.
Oliver, J. O. J. ..	Temuka.	Mackay, G. ..	Glencoe.
Stewart, J. ..	Morven.	Mackay, W. G. ..	Otawa.
Talbot, P. R. ..	Claremont.	Mackenzie, D. ..	Limehills.
		Mackenzie, K. A.	Otapiri.
Central Otago.		McLean, D. H. ..	Dipton.
Hunt, J. S. ..	Maungawera.	McLeod Bros. ..	Mandeville.
		McNaughton, J. ..	Wright's Bush.
Otago.		McRae, M. A. ..	Wyndham.
		Nicholl, N. ..	Kingston Crossing.
Blackie, W. ..	Glenoamaru.	O'Connor, J. ..	Kingston Crossing
Bradfield, W. ..	Owaka.	Riddle, H. J. ..	Thornbury.
Bunn, Mrs. A. E.	Rongahere.	Telfer, T. ..	Brydone.
Chittock, C. ..	Waikoikoi.	Tuach, J. ..	Croydon Bush.
Coulbrough, D. ..	Kelso.	Walker Bros. ..	Wendon.
Falconer, D. A. ..	Kelso.	White, R. S. ..	Otama.
Findlayson, P. ..	Crookston.	Wilson, C. ..	South Hillend.
Hayman, E. W. ..	Tuapeka Mouth.	Winsloe, J. G. E.	Waikaka.

A supplementary list will be published in a later issue of the *Journal*, together with a table showing number of areas and acreage under each certification class.

—*Fields Division.*

Compensation paid for Stock and Meat condemned.—Compensation to the amount of £17,225 was paid out during the financial year 1930–31 for animals condemned in the field for disease under the provisions of the Stock Act, and £14,496 for carcasses or parts of carcasses condemned for disease on examination at the time of slaughter at abattoirs, meat-export slaughterhouses, &c., under the provisions of the Slaughtering and Inspection Act.

THE "NEW ZEALAND CURD TEST" AND MILK GRADING.

THE curd test as a method of judging the quality of milk for cheese-making has been before factory managers and milk suppliers since the writer introduced it at many meetings of suppliers in 1901. The chief shortcoming of this test hitherto has been the attention required during the day.

Recognizing that compulsory milk-grading would necessitate the use of an efficient practical test, an endeavour has been made to avoid much of the attention hitherto required by the curd test. The writer has suggested that the bottles containing the milk, and later the curd samples, should be placed in racks which can be housed in a container, the temperature of which can be controlled, as required, by the use of steam or electricity. This idea has been developed with the assistance of Messrs. G. F. V. Morgan and M. Syron of the Dairy Division. The milk samples may be warmed in this container for renneting. Imperial half-pint bottles with cardboard stoppers are used. The bottles are fixed in the rack so that they retain their place when their containing rack is revolved. A small electric motor or a small belt from the factory main shaft can be used for revolving the horizontal shaft in the container for the test-bottle racks. When the curd is ready for breaking the power revolves the rack at the rate of about twenty-five to thirty revolutions per minute. This breaks up the curd in the bottles. The temperature inside the container is raised to about 100° F., and the revolving is continued until the curds are "cooked." The cardboard disks are then discarded and the tops of the bottles are covered with gauze which is supported in its position but so that whey may escape when the bottles are inverted. The whey is drained by giving the rack half a revolution, which inverts the bottles. The curds are thus allowed to drain, the temperature of the container being maintained until the curds are ready for examination in six to seven hours from the time of adding the rennet.

The bottles may be washed in the container by using a revolving brush fixed to the container shaft. They can afterwards be sterilized in the same container and held there until required on the receiving stage for further samples.

—*W. M. Singleton, Director of the Dairy Division.*

AREA OF GRASSLAND TOP-DRESSED, 1930-31.

THE following table, supplied by the Census and Statistics Office, shows the area of grassland in New Zealand top-dressed during the twelve months ended 31st January, 1931. Particulars of kinds of fertilizer and quantities of fertilizer and lime applied are not available for the period under review.

Land District.	Area of Grassland Top-dressed with Artificial Fertilizers once or more during Period.	Area of Grassland Top-dressed with Lime during Period.
	Acres.	Acres.
North Auckland	408,978	54,727
Auckland	883,302	168,926
Gisborne	43,059	1,835
Hawke's Bay	123,232	9,223
Taranaki	327,914	32,862
Wellington	307,290	39,761
Nelson	26,773	6,362
Marlborough	20,376	1,847
Westland	7,349	3,504
Canterbury	93,159	40,681
Otago	62,702	23,114
Southland	128,304	56,036
Total, Dominion	2,432,438	438,878

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.

MORTALITY AMONG PIGS AFTER CASTRATION.

J. K. G., Opunake :—

For the last three years deaths among my pigs, seemingly from castration, have been about 10 per cent The pigs swell up after cutting, pine away, and finally die. There are no symptoms before cutting. I always use kerosene freely after cutting. Kindly advise if kerosene is harmful, also as to treatment of the trouble generally.

The Live-stock Division :—

In all probability the deaths have occurred as a result of abscess-formation after castration has been carried out. Strict cleanliness of operating knives and surroundings must be attended to at the time of castration. Immediately after castration, owing to irritation at the site of operation, it is not unusual to see pigs contaminate the wound. Therefore clean surroundings are absolutely essential. A weak solution of one of the standard disinfectants is to be preferred to kerosene as an antiseptic. Young animals suffer less from the effects of castration than older animals. It is advisable to operate at an early age. Further information on the subject will be found in the Department's Bulletin No 150, "Castration of Pigs and Calves," a copy of which has been sent to you.

SHY BEARING APRICOT-TREE.

"AMATEUR," Taradale :—

I have an apricot-tree which has only borne half a dozen or so fruit each year for about five years. Seven years ago it had a small crop, perhaps a bushel, while a smaller-variety apricot standing next to it bears a splendid crop every year. Could you suggest what is the reason of it not bearing fruit, and the treatment to be adopted ? The fruit are very large and richly coloured, and the tree appears quite healthy, though it does not increase in size.

The Horticulture Division :—

The experience with your apricot-tree is similar to that in other fruitgrowing districts, with the exception of Central Otago and parts of the Coromandel Peninsula, where good crops of most varieties can be depended on, if late frosts do not occur. The outstanding characteristic of those localities is the low rainfall, which seems to suit the crop, specially at the time of setting. The small variety that crops well consistently is probably that known as Newcastle, which commonly has those generous qualities. Treatment that may be expected to encourage other varieties to bear would be to plant the trees on the sunny side of a wall and train them as espaliers—a method of production that is too expensive for commercial purposes. Possibly a variation of the pruning system would have some effect.

ARTICHOKE TOPS FOR ENSILAGE.

"BUTTERFAT," Tauranga :—

Could the young tops of Jerusalem artichokes be used for ensilage ? The artichokes are self-sown and fine in the stalk ; they could be mixed with Japanese millet and red clover.

The Fields Division :—

The fact that the tops of artichokes are not greatly relished by stock would indicate that the quality of ensilage made from them would probably be low. However, this should not deter you from converting them into silage, as even weeds such as Californian thistle can be utilized in this manner. With regard to

the mixing of these tops with Japanese millet and red clover, we would suggest that you ensile the artichoke tops separately (if sufficient bulk of them is available), as both millet and red clover are of superior quality for this purpose, and would consequently make better ensilage if kept apart from the tops. You may then at a later date be able to arrange your feeding-out so as to give springing and milch cows the millet and clover ensilage, while dry stock might receive the artichoke tops, or a portion of them with millet and clover ensilage.

ESTIMATED YIELDS OF WHEAT, OATS, AND BARLEY.

THE following estimated average yields per acre of wheat, oats, and barley for the season 1931–32 have been compiled by the Census and Statistics Office from reports furnished by Inspectors of the Department of Agriculture throughout the Dominion, and issued under date 10th February :—

District.	Wheat. Bushels per Acre.	Oats. Bushels per Acre.	Barley. Bushels per Acre.
North Island	28·23	33·49	42·28
Nelson	19·04	21·08	18·16
Marlborough	28·18	30·73	28·07
Canterbury	23·76	26·25	27·54
Otago	25·69	33·99	29·59
Southland	35·70	44·36	34·63
Average (estimated) for the Dominion, season 1931–32	24·44	32·56	28·79
Average (actual), for the Dominion, season 1930–31	30·44	38·74	34·97

In accordance with the above estimates, the total yield of wheat for the season 1931–32 should be approximately 6,660,000 bushels, as against an actual yield of 7,579,153 bushels for the season 1930–31.

The proportion of oats threshed for the five seasons ending with 1930–31 averaged 26·57 per cent. of the total area under that crop. Assuming that a similar proportion is threshed this year, the total yield of grain should be approximately 2,850,000 bushels, as against an actual yield of 3,376,600 bushels for the season 1930–31.

Assuming that the percentage of the barley area threshed remains the same as last year, the total yield of grain should be approximately 530,000 bushels, as against an actual yield of 837,696 bushels for the season 1930–31.

FERTILIZER IMPORTATIONS: DECEMBER QUARTER.

FOLLOWING are particulars of importations of fertilizers into New Zealand for the quarter ended 31st December, 1931 :—

Sulphate of Ammonia : United Kingdom, 1,575 tons. *Nitrate of Soda* : Chile, 670 tons. *Basic slag :* United Kingdom, 125 tons; Belgium, 430 tons. *Chardust and bonechar :* Australia, 20 tons. *Guano :* United Kingdom, 15 tons; Madagascar, 793 tons; New Caledonia, 3,600 tons. *Rock phosphate :* Ocean Island, 18,120 tons; Nauru Island, 20,986 tons; Tuamotu Archipelago, 7,376 tons. *Superphosphate :* Netherlands, 100 tons. *Phosphates (other) :* United Kingdom, 25 tons; Belgium, 100 tons. *Kainit :* France, 9 tons; Poland 50 tons *Muriate of potash :* France, 10 tons. *Sulphate of potash :* Belgium, 5 tons; France, 48 tons; Germany, 200 tons. *Potash (other) :* Belgium, 5 tons; France, 171 tons; Germany, 415 tons; Poland, 206 tons. *Sulphate of iron :* United Kingdom, 9 tons; Australia, 11 tons.

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TESTING OF PUREBRED DAIRY COWS.

REVIEW OF THE NEW ZEALAND CERTIFICATE-OF-RECORD SYSTEM IN 1931.

W. M. SINGLETON, Director of the Dairy Division, Wellington.

THE records of milk and butterfat yield included in this survey relate for the most part to cows calving for commencement of test during the calendar year 1930, and to practically all qualifying for certificate in 1931. When the entries were made the effects of the gathering depression were as yet scarcely in evidence, and so far as C.O.R. testing is concerned apparently did not then exist, as the number of cows placed under test showed a decided increase over the previous year. Despite the larger membership a creditable increase in average production was recorded in 1931, and the year was also an exceptional one from the point of view of the many outstanding individual yields authenticated.

The first year of the C.O.R. 305-day test is now completed, and the advent of this class necessitates dividing the present review into two sections. During the year 630 first-class certificates were issued to cows qualifying under the rules for the yearly test, and 107 under those for the 305-day division, so that entries in the latter class represented approximately one-seventh of the total for the year. Some 268 breeders were represented in the year's testing. Of these, 224 made entries for the full-year class, and twenty in the ten months' class, while twenty-four gained certificates in both classes. For the peak month (December) of the year 1930 982 cows were being tested, these being in the ownership of 302 breeders, thus making an average of 3·22 cows per breeder. The corresponding figures for December, 1931, were 637 cows in the hands of 231 breeders, the influence of the depression being conspicuous.

The average butterfat yield represented by the 630 C.O.R. yearly test certificates issued in 1931 was 495·17 lb., as compared with 474·02 lb. for 1930. In comparing these two figures, however, it should not be overlooked that commencing with 1931 the minimum butterfat requirement for cows on C.O.R. test was increased by 35 lb. As a result a number of the lower producers would be eliminated and the average automatically raised. A survey of the records for those cows which

failed to qualify on production under the new standards, but would have been eligible under the original butterfat requirements, indicates that some twenty-eight cows were excluded, there being eighteen Jerseys, one Friesian, six Ayrshires, and three Milking Shorthorns whose final yields lay between the old and the new minimum standards.

(1) C.O.R. Yearly Test Division.

FIRST-CLASS CERTIFICATES ISSUED.

The C.O.R. system was commenced in 1912, and from its inception to the end of the calendar year 1931 first-class certificates have been issued to 7,734 cows. Classified under the various breeds, Jerseys are represented by 5,491 cows, Friesians 1,569, Milking Shorthorns 408, Ayrshires 205, Red Polls 60, and Guernseys 1. Particulars of certificates issued during the past two years are given in Table 1. It must be kept in mind that all performances dealt with in this section of the review relate to the yearly test; the C.O.R. 305-day test is dealt with later in the review.

Table 1.

Breed.	1931.			1930.		
	Ordinary.	Repeat.	Total.	Ordinary.	Repeat.	Total.
Jersey	459	44	503	454	54	508
Friesian	74	21	95	78	18	96
Milking Shorthorn..	17	1	18	21	2	23
Ayrshire	11	..	11	13	1	14
Red Poll	2	1	3	2	..	2
Totals ..	563	67	630	568	75	643

SECOND-CLASS CERTIFICATES.

Only thirty-five second-class certificates were issued during the year, or one more than for 1930, showing that around 95 per cent. of the cows qualified for first-class certificate by calving within fifteen months after the date of calving for commencement of test (the rules allow an extra thirty days for second-class certificate). Of the thirty-five second-class certificates gained thirty-one went to Jerseys, three to Friesians, and one to a Milking Shorthorn. The numbers are too small to warrant subdivision into age classes, but the thirty-one Jerseys averaged 452·93 lb. of butterfat, and the three Friesians 565·79 lb., while the Milking Shorthorn yielded 718·38 lb.

PERIOD BETWEEN CALVINGS.

The 630 cows qualifying for first-class certificate in 1931 went an average period of 397 days between calvings, while the average for the 643 cows of 1930 was 390 days. Seeing that the maximum allowed is 455 days, it is apparent that the average cow calved well within her time limit.

For second-class certificate the maximum period is 485 days, and here again the average was within safe distance of the margin, the average for 1931 being 461 days as compared with 466 days for 1930.

JERSEYS.

Class-leaders.

With the exception of the junior two-year-olds, the Jersey class-leaders remain as at the close of 1930, when Mr. R. S. Tuck's Ivondale Oxford Lass held the record with a production of 731·29 lb. butterfat. The new leader of the class is Coniston Goldie, bred and tested by Mr. R. Waterhouse, of Ardmore, Papakura, this heifer having advanced the class record to 742·71 lb. Coniston Goldie was milked only twice daily for 308 of the 365 days she was on test. The junior two-year-old class was a particularly interesting one in 1931, there being no less than three heifers which broke the class record, their monthly performances progressing within such narrow limits as to leave the issue in doubt until almost the last month of the test. While Coniston Goldie finally won the senior place, Ashton Olive's Pet, bred and tested by Mr. R. L. Parkin, Bell Block, finished her year with 736·94 lb. butterfat to her credit, and Bridge View Jersey Queen, bred and tested by Mr. A. L. Hooper, Brixton, gained her certificate on a production of 733·94 lb. Both cows were milked only twice daily during the whole of the testing-period. Moreover, the age at commencement of test for the three cows was remarkably close. Coniston Goldie, as will be seen from Table 2, was 2 years 40 days; Ashton Olive's Pet was 2 years 44 days; and Bridge View Jersey Queen exactly 2 years.

The highest yield for the year, irrespective of age, was that of Cytherea's Twylish Cream, a three-year-old bred by Mr. W. H. Wallace, of Huiroa, and owned and tested by Mr. E. J. Clough, of Inglewood. Cytherea's Twylish Cream commenced test at the age of 3 years 331 days, and is credited with 840·41 lb. butterfat. She was milked twice daily throughout the period of test.

The full list of Jersey class-leaders is as follows:—

Table 2.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season. Days.	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Coniston Goldie ..	R. Waterhouse, Papakura	2 40	244·5	365	10,759·4	742·71
Senior Two-year-old.						
Ivondale Golden Rainbow	P. J. Petersen, Waitara	2 311	271·6	365	12,962·2	768·46
Three-year-old.						
Ivondale Silver Rainbow	P. J. Petersen, Waitara	3 327	309·7	365	15,073·4	950·63
Four-year-old.						
Keston Flower ..	G. E. Yelchich, Waiuku	4 64	319·9	365	14,679·2	814·95
Mature.						
Holly Oak's Annie..	W. T. Williams, Pukehou	5 9	350·0	365	18,522·7	1,056·49

FIG. 1. CONISTON GOLDIE (R. WATERHOUSE, PAPAKURA).

Leader of the Jersey junior two-year-old class: 10,759·4 lb. milk, 742·71 lb. butterfat.

Jersey Class Averages.

During the period under review certificates were issued to 503 Jerseys in this yearly division, their average production being 486·25 lb. butterfat, as compared with 466·78 lb. for the 508 Jerseys certificated in the calendar year 1930. Increases are recorded in each of the five classes into which this breed is subdivided.

The class averages for 1931 and 1930 are shown in the following table :—

Table 3.

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
	1931.		lb.	lb.
Junior two-year-old ..	191	353	7,513·6	427·23
Senior two-year-old ..	62	347	8,070·5	460·11
Three-year-old	66	348	9,046·7	509·36
Four-year-old	49	354	9,657·3	549·56
Mature	135	350	9,914·7	547·49
	1930.			
Junior two-year-old ..	200	349	7,273·3	406·21
Senior two-year-old ..	52	342	7,631·7	439·87
Three-year-old	60	340	8,829·0	503·01
Four-year-old	69	342	9,153·3	505·27
Mature	127	344	9,690·2	535·16

The averages, class by class, of all certificates issued to Jersey cows since the commencement of the C.O.R. system are given in Table 4. As might be expected from the marked increase for the year, the average

to date has climbed to a still higher point. The 6,000 certificates mark, and the 450 lb. butterfat mark, have both been passed since our last summary was published.

Table 4.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Junior two-year-old ..	2,466	346	7,051·4	394·94
Senior two-year-old ..	663	345	7,763·7	438·49
Three-year-old	921	343	8,471·8	472·78
Four-year-old	626	345	8,981·3	499·19
Mature	1,542	345	9,410·6	516·55
All .. .. Average test, 5·56.	6,218	345	8,117·1	451·77

Jersey C.O.R. Bulls.

The 5,491 Jersey cows which have received certificates to date were sired by 1,994 bulls. Of these sires 393 are sires of four or more daughters with first-class certificates of record, each daughter being from a different dam, and are therefore entitled to be classed as C.O.R. bulls. Some forty new C.O.R. bulls were added during the year. Three names were added to the champion butterfat bull class, which now stands at *thirteen*. The qualifications for entry in this class, which is a special one inaugurated by the New Zealand Jersey Cattle Breeders' Association, are as follows: Each bull must have five or more daughters (each from a different dam) which under first-class C.O.R. conditions have produced 520 lb. butterfat when starting test up to three years of age, 580 lb. when starting between three and four years old, 640 lb. when starting between four and five years of age, or 700 lb. when five years old or over. (Note.—For cows in the 305-day test the butterfat requirement is 25 lb. less in each case, which is in keeping with the difference in standards for the two divisions.)

FRIESIANS.

Class-leaders.

From the point of view of the Friesian breed 1931 must be recorded as a remarkable year on account of the many fine performances recorded. Credit for outstanding achievement is due to the Piri Land Co., whose test team comprised entries for six out of the seven classes recognized by the New Zealand Friesian Association, and terminated the year's work with the highest record for the year for each of those six classes, one being a 1,000 lb. butterfat record and another a class-leadership. The new class-leader is Totara C. R. Buttercup, a senior three-year-old, whose yield of 989·10 lb. butterfat from 25,885·3 lb. milk exceeds the performance of Manor Beets Daughter 2nd of Ashlynn by 125 lb. butterfat and more than 7,000 lb. milk, the previous record having stood since 1915. The 1,000 lb. butterfat record referred to is that of Totara Sylvia Colantha, the exact figures being 1,024·37 lb.

from 26,310·1 lb. milk in 365 days. This is the seventh New Zealand cow to gain a first-class C.O.R. on a yield of over 1,000 lb. butterfat. Other Piri Land Co. cows which qualified in 1931 are: Totara Veeman Lulu, a junior two-year-old, with 723·36 lb. butterfat (only 17 lb. below the existing class-leadership); Totara K. P. Stella, a senior two-year-old, with 632·09 lb.; Totara K. P. Prudence, a junior three-year-old, with 707·67 lb.; and Totara Sylvia Trixy, a junior four-year-old, with 831·82 lb. This achievement as a whole is unexcelled in our C.O.R. test history. The honour of the highest record for the year for the remaining class, the senior four-year-old, goes to Mr. O. A. Cadwallader, of Greytown, whose Roslyn Princess Fobes gained a certificate for 719·84 lb. butterfat.

Following are particulars of the records of the seven cows which, up to the close of the calendar year 1931, have been granted first-class certificates under the C.O.R. test on yields of 1,000 lb. butterfat or over:—

Table 5.

Name of Cow.	Breed.	Yield.			Age at Start of Test.	
		Days.	Milk.	Butterfat.		
			lb.	lb.	Yrs.	days.
Alcartra Clothilde Pietje	Friesian ..	365	31,312·5	1,145·24	7	357
Holly Oak's Annie ..	Jersey ..	365	18,522·7	1,056·40	5	9
Hilda Minto de Kol ..	Friesian ..	365	27,773·8	1,046·31	12	56
Vivandiere	Jersey ..	365	17,282·1	1,036·09	6	10
Totara Sylvia Colantha	Friesian ..	365	26,310·1	1,024·37	5	220
Pretty's Flirt ..	Jersey ..	365	16,684·1	1,010·49	6	353
Monavale Queen Bess ..	Friesian ..	365	26,461·8	1,002·20	7	363

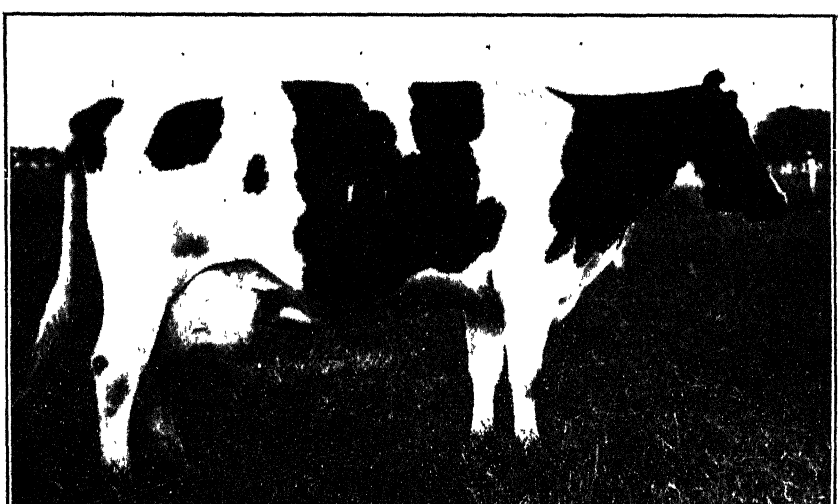

FIG. 2. TOTARA SYLVIA COLANTHA (PIRI LAND CO., AUCKLAND).
C.O.R. in Friesian mature class: 26,310·1 lb. milk, 1,024·37 lb. butterfat.

FIG. 3. TOTARA C. R. BUTTERCUP (PIRI LAND CO., AUCKLAND).
Leader of the Friesian senior three-year-old class: 25,885·3 lb. milk, 989·10 lb. butterfat.

The list of Friesian class-leaders is now as follows :—

Table 6.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
		Yrs. dys	lb.		lb.	lb.
Junior Two-year-old. Monavale Queen Bess	T. H. Richards, Cardiff	2 16	242·1	365	20,501 1	740·50
Senior Two-year-old. Pareora Echo Blossom	T. Sheriff, Clandeboye	2 223	262·8	365	22,671·9	819·81
Junior Three-year-old. Monavale Queen Bess	T. H. Richards, Cardiff	3 56	282·6	365	21,609·3	800·18
Senior Three-year-old Totara C. R. Buttercup	Piri Land Co., Auckland	3 247	336·7	365	25,885·3	989·10
Junior Four-year-old. Westmere Princess Pietertje	John Donald, Westmere	4 156	329·1	365	24,199·0	939·78
Senior Four-year-old. Bainfield 27th ..	C. H. Potter, Pukerau	4 351	348·6	365	23,203·3	910·74
Mature. Alcartra Clothilde Pietje	Vernon Marx, Mangatoki	7 355	350·0	365	31,312·5	1,145·24

Friesian Class Averages.

In 1931 some ninety-five certificates in the yearly division were issued to Friesian cows, as compared with ninety-six certificates in 1930. The breed as a whole had an average production for the year of 559·01 lb. butterfat, an increase of no less than 30 lb. over the 1930 figure of 528·04 lb. All the class averages reached a very high standard, but annual comparisons are of little value on account of the small number of animals in some of the classes and the consequent disproportionate influence of individual performances. The class averages for 1931 and 1930 are as follows:—

Table 7.

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
	1931.		lb.	lb.
Junior two-year-old ..	33	346	13,997·1	500·25
Senior two-year-old ..	6	347	14,025·4	500·51
Junior three-year-old ..	7	349	15,069·2	528·10
Senior three-year-old ..	11	337	14,441·5	529·48
Junior four-year-old ..	8	345	16,719·5	608·30
Senior four-year-old ..	6	360	16,629·6	599·53
Mature	24	352	18,115·6	650·40
	1930.			
Junior two-year-old ..	36	340	12,377·3	443·26
Senior two-year-old ..	13	356	15,061·6	539·11
Junior three-year-old ..	10	354	14,382·2	500·17
Senior three-year-old ..	4	349	16,714·4	577·10
Junior four-year-old ..	3	333	11,264·1	411·05
Senior four-year-old ..	9	352	17,834·2	620·68
Mature	21	350	16,586·2	614·48

The averages, class by class, of all certificates issued to Friesian cows since the commencement of the C.O.R. system are given in the following table:—

Table 8.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Junior two-year-old ..	569	344	11,692·0	414·41
Senior two-year-old ..	247	347	12,585·1	446·75
Junior three-year-old ..	179	342	13,365·7	469·15
Senior three-year-old ..	179	336	13,842·7	495·43
Junior four-year-old ..	116	344	14,966·5	528·80
Senior four-year-old ..	120	346	15,866·2	553·19
Mature	524	341	15,868·5	556·43
All .. .. Average Test, 3·52.	1,934	343	13,747·0	485·06

Friesian C.O.R. Bulls.

The Friesian C.O.R. bulls now total 107, four new bulls having qualified during the year. The number of sires represented in the 1,569 Friesian cows certificated to the end of 1931 is 556.

MILKING SHORTHORNS.

Class-leaders.

The past year was uneventful so far as the Milking Shorthorn breed is concerned, there being no records of outstanding merit, nor any which seriously challenged the existing class-leaderships. The list remains as follows:—

Table 9.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Matangi Quality 4th	Ranstead Bros., Matangi	2 109	251·4	365	14,572·8	591·89
Senior Two-year-old.						
Matangi Quality 5th	Ranstead Bros., Matangi	2 204	260·9	365	11,752·8	542·66
Junior Three-year-old.						
Matangi Quality 4th	Ranstead Bros., Matangi	3 153	292·3	365	16,281·4	678·02
Senior Three-year-old.						
Matangi Ruth 2nd..	Ranstead Bros., Matangi	3 304	307·4	365	14,032·7	747·86
Junior Four-year-old.						
Matangi Matilda 4th	Hon. Mrs. E. J. Blyth, Kohimarama	4 0	313·5	358	14,640·2	630·38
Senior Four-year-old.						
Matangi Ruth 2nd..	Ranstead Bros., Matangi	4 355	349·0	340	11,670·3	644·90
Mature.						
Glenthorpe Lady ..	A. J. Melville, Buckland	Mature	350·0	365	20,136·2	856·85

Milking Shorthorn Class Averages.

Eighteen Milking Shorthorns, with an average production of 446·13 lb. butterfat, were tested in 1931, compared with twenty-three with an average of 449·44 lb. for the preceding year. Only five out of the seven classes recognized by this breed were represented, there being no certificates gained in the junior two- or junior four-year-old class. There were four senior two-year-olds averaging 370·53 lb. butterfat, two junior three-year-olds averaging 422·89 lb., three senior three-year-olds averaging 394·99 lb., three senior four-year-olds averaging 400·23 lb., and six mature cows averaging 552·79 lb. With so small a number the presentation of a table of class averages is scarcely justified.

The averages, class by class, of all certificates issued to Milking Shorthorn cows since the commencement of C.O.R. testing for this breed in 1914 are shown in Table 10, which follows.

Table 10.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk	Butterfat.
			lb.	lb.
Junior two-year-old* ..	53	348	8,374·6	343·79
Senior two-year-old ..	34	347	8,813·9	359·55
Junior three-year-old ..	24	334	9,689·3	387·13
Senior three year-old ..	27	341	10,621·9	442·34
Junior four-year-old* ..	21	347	11,081·6	444·99
Senior four-year-old ..	30	342	11,440·3	452·00
Mature	260	341	11,746·6	471·29
All .. .. Average test, 4·02.	449	342	10,897·3	439·02

* No additions in 1931.

Milking Shorthorn C.O.R. Bulls.

The number of C.O.R. bulls of this breed remains at twelve, no new names having been added during the year. The 408 cows certificated to the end of 1931 were sired by 128 different bulls.

AYRSHIRES.

Class-leaders.

No new Ayrshire class-leaders appeared during the year under review, neither were any outstanding performances recorded. The list is repeated as follows :—

Table 11.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Two-year-old.						
Fair Maid of Greenbank	W. Moore, Homebush	2 27	243·2	365	12,281·3	673·56
Three-year-old.						
Maesgwyn Victoria ..	C. Morgan Williams, Kaiapoi	3 250	302·0	365	16,507·7	646·98
Four-year-old.						
Ivanhoe Fancy ..	A. M. Weir, Menzies Ferry	4 308	344·3	365	14,207·7	713·93
Mature.						
Floss of Braeside ..	W. Moore, Homebush	7 287	350·0	365	20,305·5	832·72

Ayrshire Class Averages.

Eleven first-class certificates were issued to Ayrshire cows in 1931, as against fourteen in 1930, the average butterfat production figures being 428·84 lb. and 458·40 lb. respectively. Classifying according to age the eleven certificates issued last year, it is found that there were

three cows in the two-year-old class, with an average of 409·95 lb. butterfat; two three-year-olds averaging 429·96 lb.; one four-year-old with 427·89 lb.; and five mature cows averaging 439·91 lb.

The averages, class by class, for all certificates issued to Ayrshire cows since the commencement of C.O.R. testing in 1912 are supplied by the following table:—

Table 12.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk	Milk.	Butterfat.
			lb.	lb.
Two-year-old	59	344	8,862·9	368·41
Three-year-old	38	347	10,043·0	414·16
Four-year-old	26	346	11,218·0	453·62
Mature	108	349	11,914·5	484·76
All .. .. Average test, 4·09.	231	347	10,748·8	439·92

Ayrshire C.O.R. Bulls.

Two new names were added to the Ayrshire C.O.R. bull list during the year, the total now being nine. The 205 Ayrshire cows with first-class certificates-of-record were the daughters of 118 sires.

Red Polls.

Three Red Poll cows gained certificates in 1931, one of these, Waihou Pip, owned by Mr. W. Jackson, of Waihou, winning the leadership of the mature class from Mr. G. S. Young's Wayward 6th B. No. 1, with 537·90 lb. butterfat, a narrow margin of 1·40 lb. Mr. Jackson's Waihou Best Girl, a three-year-old, produced 445·16 lb., a creditable performance. The third Red Poll cow under test last year was Winsome 12th, in the mature class, owned by Sir Heaton Rhodes, of Tai Tapu; her production of 534·54 lb. in 351 days came very near that of both the new and the old leader of the class.

The Red Poll class-leaders are now as follows:—

Table 13.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Two-year-old.						
Wayward 6th B No. 1	G. S. Young, West Plains	2 188	259·3	365	11,228·0	511·42
Three-year-old.						
Dominion Gold Top..	Central Development Farm, Weraroa	3 302	307·2	365	9,491·25	459·46
Four-year-old.						
Wayward 6th B No. 1	G. S. Young, West Plains	4 297	343·2	365	13,290·0	580·05
Mature.						
Waihou Pip	W. Jackson, Waihou	7 25	385·0	365	12,681·8	537·90

The averages, class by class, for all certificates issued to Red Poll cows since the commencement of C.O.R. testing for this breed in 1918 are as follows:—

Table 14.

Class.	Number of Certificates.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
			lb.	lb.
Two-year-old*	37	343	7,580·1	337·61
Three-year-old	14	348	8,004·4	350·45
Four-year-old*	6	343	9,909·1	425·86
Mature	22	337	10,483·5	441·28
All Average test, 4·34.	79	342	8,640·77	375·46

* No additions in 1931.

Red Poll C.O.R. Bulls.

The Red Poll C.O.R. bull list remains unaltered, and numbers three. Altogether twenty-five sires are represented by the sixty Red Poll cows so far certificated.

(2) C.O.R. 305-day Test Division.

Briefly expressed, the C.O.R. 305-day test varies from the C.O.R. yearly test in three main points—namely, maximum duration of test, period between calvings, and minimum butterfat requirement. The maximum testing period is 305 days, as against 365; the period between calvings for first-class certificate is 395 days, as compared with 455 days; while the butterfat standard increases from 250·5 lb. for a two-year-old to 360 lb. for a mature cow, as against 275·5 lb. to 385·0 lb. in the yearly test. As will be seen, the standard in the 305-day class is 25 lb. of butterfat less than in the full-year division.

First-class Certificates issued.

Only three breeds gained certificates under this branch of the C.O.R. test, no 305-day entries having been received from the Ayrshires or Red Polls. Particulars of number of certificates issued are as follows: Jerseys, 97; Friesian, 9; Milking Shorthorn, 1: a total of 107.

Second-class Certificates.

One second-class 305-day certificate was issued during the year, this being a three-year-old Jersey, which failed by some ten days to calve subsequent to test within the 395 days stipulated by the rules.

Jerseys.

Class Averages.

In Table 15 are given the averages, class by class, of the ninety-seven certificates issued during 1931 to Jersey cows in the 305-day division test. The average for all cows was 421·12 lb. butterfat, the average test being 5·58 per cent.

Table 15.

Class.	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Butterfat.
	1931.		lb.	lb.
Junior two-year-old ..	39	302	6,553·6	373·49
Senior two-year-old ..	5	304	8,163·5	460·23
Three-year-old	13	296	7,556·2	424·09
Four-year-old	15	302	8,216·6	458·40
Mature	25	302	8,527·0	463·69

Jersey Class-leaders.

The first year's Jersey class-leaders under the 305-day test are given in Table 16. Considering the length of lactation and the small number of entries some of the yields, particularly those in the younger classes, must be considered as decidedly creditable.

Table 16.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Fat.
Junior Two-year-old.		Yrs.dys.	lb.		lb.	lb.
Beloved	R. S. Tuck, Waharoa	1 328	250·5	305	9,337·5	500·36
Senior Two-year-old.						
Erinview Choice ..	J. Murray, Woodville	2 344	284·9	305	9,798·7	559·42
Three-year-old.						
Brentwood Emerald	C. A. Willis, Pukekohe	3 357	322·7	305	10,585·9	608·13
Four-year-old.						
Brentwood Lady Winnie	C. A. Willis, Pukekohe	4 11	324·6	305	10,297·3	535·47
Mature.						
Woodlands Veta ..	H. C. Sampson, Hillsborough	7 351	360·0	305	9,463·0	578·34

FRIESIANS.

Class Averages.

There having been only nine Friesian certificates issued in the 305-day class, a class-average table is obviously of little value. The nine certificates averaged 423·64 lb. butterfat, with an average test of 3·57 per cent.

Class-leaders.

Table 17 gives the highest Friesian yields for each class represented in the 305-day division during the year. Entries were received for only five of the seven classes into which this breed is usually subdivided.

Table 17.

Name of Cows and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Butter-fat.
		Yrs. dys.	lb.		lb.	lb.
Junior Two-year-old.						
Waterloo Queen Helen Beets	R. S. Tuck, jun., Waharoa	2 4	250·9	305	11,585·5	425·48
Senior Two-year-old.						
Rosevale Beauty Posch Griselda	E. H. Watson, Windsor	2 216	272·1	305	12,273·5	468·50
Junior Three-year-old	..	..	..	..	..	..
Senior Three-year-old.						
Sealands Alcartra Fobes	H. G. A. Cameron, Weraroa	3 304	317·4	305	10,407·8	389·04
Junior Four-year-old	..	..	..	..	..	..
Senior Four-year-old.						
Ellerlea Aaggie Segis Minto	C. H. Steadman, Pokapu	4 357	359·2	305	15,311·9	557·71
Mature.						
Ellerlea Countess Minto De Kol	C. H. Steadman, Pokapu	8 139	360·0	305	12,761·3	454·11

Milking Shorthorns.

One cow of the Milking Shorthorn breed gained a certificate in the 305-day class. This cow, Pinedale Rona, owned by Mr. G. D. Hall, Kiokio, Otorohanga, commenced test at the age of 3 years 35 days, and is credited with a production of 8,862·4 lb. milk, containing 416·51 lb. butterfat, in 305 days.

The thanks of the Dairy Division are once more due for the assistance and friendly co-operation of the secretaries of the various breeders' associations whose breeds take part in certificate-of-record testing.

Summer Application of Winter Oils in Orchard Practice.—Many growers in the Mapua district (Nelson) have experienced much difficulty in obtaining perfect emulsions of the winter oils for summer application, following lime-sulphur. The cause appears to be mainly due to the absorption of sulphur compounds by the wooden vats, and the trouble cannot be overcome by washing with water no matter how thoroughly the operation is performed. Even growers of long experience have sustained damage from the use of oils where a reasonable quantity of the emulsified oil is not run through the pipes to remove all traces of the lime-sulphur previously used. The trouble has been quite successfully overcome by mixing a small quantity of primary emulsion in a tin vessel, and employing the emulsion to bathe the sides of the vat. Apparently the effect is that it seals the pores of the wood and acts as an interception agent between the oil and the sulphur. The use of soap-powder is also very helpful if used in the water for making primary emulsion at the rate of 2 oz. to 4 gallons of water, this being much preferable to soda.—*M. Davey, Orchard Instructor, Mapua.*

IRON LICKS FOR BUSH SICKNESS.

FURTHER EXPERIENCES WITH SHEEP AND CATTLE.

B. C. ASTON, Chief Chemist, Department of Agriculture.

Now that the correct treatment of the group of deficiency diseases known as "bush sickness" in New Zealand, "coast disease" in Tasmania, "nakuruitis" in Kenya, "salt sick" in Florida, and "pining" in Scotland, is recognized to be the administration of iron, preferably to the animal automatically as a salt lick, the practical treatment of bush sickness in the field is narrowed down to the selection of the most efficacious form of iron obtainable.

Since 1914 various sources of iron obtainable in this Dominion have been the subject of experiment at the Mamaku Demonstration Farm, where a paddock was dressed with limonite as early as November, 1914. Being restricted to sources which were accessible as well as suitable, the following were the forms of iron experimented with in chronological order: (1) Limonite from Whangarei, 1914; (2) gasworks spent oxide of iron made from the Whangarei material, 1915; (3) limonite from Onekaka, Nelson, December, 1924; (4) spathic iron ore, Huntly, 1926.

Of these when applied as a dressing for pasture the only one which gave any success was the spent oxide from the Auckland or Hamilton gasworks, which was applied at the rate of 10 cwt. per acre. This experiment was notable as showing the efficacy of spent oxide in keeping grown sheep healthy for a much longer time on affected country than otherwise would be possible (see this Department's annual report for the year 1916–17, p. 13).

Spent iron oxide from gasworks is obtainable at a nominal cost. Apart from its soluble iron content it contains nitrogenous compounds which are useful as a pasture top-dressing. In excess, however, it is used as a weed poison for paths and roads, and owing to the contained poisonous properties it cannot be used as a stock-lick.

Of the three other iron compounds available, the Onekaka hydrated oxide (limonite)—of which some tons were specially ground for Mamaku in December, 1924, and subsequently—was tried as a sheep-lick, but found to be too coarsely ground, the sheep refusing to take it when mixed with salt.

The impure carbonate of iron from the Huntly clay-pit, first obtained in 1926, was experimented with at considerable length after finely grinding the raw material (a costly matter) in a phosphate mill. This gave satisfactory results with cattle as a lick, with calves mixed in their feed-milk, and also as a lick, and with sheep when fed as pellets. (See this *Journal* for January, 1929, p. 14; April, 1929, p. 233; March, 1930, p. 188; June, 1931, p. 369; July, 1931, p. 11.) The quality of this material, however, is variable. In some ground samples it has been found by chemical analysis to vary so much as 10 per cent. in the siliceous matter. The Whangarei limonite is now proving superior in treating sheep.

An error crept into a recent report in which it was stated that Scotch bog iron (impure limonite) was used in Kenya. This now turns

out to be a mistake, the material there used being hæmatite, so that the New Zealand Department is entitled to the credit of being the first to use the limonite as a lick for supplying food-iron to stock.

The Whangarei material is the softest of the three crude iron ores mentioned. It is already marketed in considerable quantities by the owners of the two deposits at Whangarei for the purpose of purifying coal-gas, some 500 tons a year being handled. With very little extra trouble the material is being screened or otherwise reduced to a powder finer than that used in gasworks, and the deposits are close to rail and harbour for transport to every iron-hungry animal in the North Island.

Farmers' Experiences in Treatment.

A number of further replies from farmers in the bush-sick districts have come in giving the results of their experience in using spathic iron ore as a lick. A Tauranga farmer, under date 2nd January, 1932, writes :—

We first tried it mixed with 33⅓ per cent. of salt, which the cows did not take to kindly. We then increased the quantity of salt to a 50-50 basis, reserving a little salt for the top of containers which we moistened. This formed a crust and the cattle took to it readily. So far not one of the 130 dairy cows have shown any sign of sickness. They are in splendid condition and their coats shine like silk, which undoubtedly proves the mixture is very beneficial to them. The calves have had small quantities mixed with their milk, and they have thrived exceptionally well.

An Omanawa farmer writes under date 11th January, 1932 :—

In reporting on the results of using the carbonate of iron I may say that I have given it to the milking-cows in the bails, and in the paddock for the young stock, also as a lick for the calves. I have not had a sick beast on the farm since I commenced to use the lick.

A Tokoroa farmer, under date 14th December, 1931, writes :—

I found the cattle took to the mixture as advised by the Department readily and without any trouble. I have not used any other lick for four years, and have had less trouble *re* sickness during this period than during my seven years here. My cows this year are looking splendid, my two- and three-year-old heifers are a picture. I still have the same bull that I bred here six years ago.

A Poverty Bay back-country farmer writes under date 17th December, 1931 :—

My ram hoggets did wonderfully well after I started feeding iron and salt and bonedust as per your instructions, and although sheep throughout the district have done exceptionally well this season the change was so prompt and outstanding that I give credit to the lick.

A Te Puke farmer, under date 28th December, 1931, writes :—

I find the iron readily taken by stock when mixed with equal parts of steamed bone-flour and iodized salt. I have found no difficulty in keeping animals in health by using the mixture. To prove this I put a portion of my dairy herd on swamp country last winter and kept a portion back. They received nothing but rough feed and the lick. Those that were on the swamp came in weak and thin, while those that were kept behind came in in fine fettle, showing neither weakness nor any debility. The feed on the swamp was mixed pasture but not top-dressed. I find that the cows that remained at home and had access to the lick are milking considerably better than the others grazed on the swamp, and came right to their milk after calving, while the remainder are only getting into their stride now. I find the iron most beneficial when used with the other two ingredients. I gave the iron mixed with meat-meal to my calves in their daily milk ration at the rate of ½ oz. of iron to 3 oz. of meat-meal in one gallon of separated milk, from the fourteenth day till the end of the third month, and

they have never looked behind them. I have the finest calves this year I have ever reared. They have constant access to the lick and plenty of water.

A Pikowai farmer, under date 3rd January, 1932, writes :—

I have mixed the carbonate of iron and salt and find my dairy cows like it. Of course, some take much more than others and some none at all. I suppose those do not require it. I have generally given my calves iron citrate in their skim milk, but this year have given them the carbonate instead plus a little meat-meal, and the calves have done remarkably well

A Rotorua farmer gives, under date 10th January, 1932, his experience with the half-and-half iron oxide and salt mixture as follows :—

Two calves went sick after weaning One improved after I placed the lick in a handy position ; the other would not take the lick, so I gave it about a teaspoonful in the mouth dry daily, and there was a very definite improvement in about a week. It appears to be now quite normal. The rest of the calves are taking the lick and are quite normal, though they received very little citrate in the milk. I think the placing of the lick in a handy position is all that is required for rearing calves, and any not taking it should be treated as above. The advantage of training calves to take the lick when young is quite apparent, at least in most cases, and in regard to this I think that it is very important to get stock on to the lick while in robust condition, as the more vigorous stock appear to take the lick most readily.

The Atiamuri Experiment with Sheep: Success of Hydrated Oxide of Iron (Limonite).

Early in May, 1931, an experiment with sheep was inaugurated at Atiamuri to determine whether lambs could be successfully reared on this country with the aid of a lick supplying food-iron. The land is a poor volcanic type, originally in scrub (manoao and manuka). The pasture on the hills is much better than on the flats, the soil of which is often of a coarse pumiceous nature, technically a sandy silt, whereas the soil on the hills is finer in texture with a retentive subsoil below 18 in. The pasture is of a better quality than that of the unmanured land found in the vicinity, cocksfoot, timothy, rye-grass, Poa pratensis, and clovers being present, the practice of top-dressing annually with 2 cwt. of superphosphate per acre having been followed for some years.

Last autumn the usual dressing was changed for one consisting of equal parts of superphosphate and basic slag at the rate of 2 cwt. per acre of the mixture. No difference was made in the grazing of any group of sheep, the whole flock having practically the same treatment, with the exception of those receiving lick treatment. From a flock of two thousand ewes four groups of fifty each were selected, the age of the animals being between two and three years, all of which had been on the property for not less than two years. The groups were treated as follows :—

No. 1 : Control, no lick.
No. 2 : Lick containing iron ammonium citrate and salt.
No. 3 : Lick containing hydrated iron oxide (Whangarei) and salt.
No. 4 : Lick containing spathic iron ore and salt.

All groups grazed the same sets of paddocks in rotation, thus eliminating any possible advantage derived from difference in grazing. No difficulty was experienced in getting the ewes to take the iron oxide lick, but difficulty was experienced in getting them to take the iron ammonium citrate lick, which was only sparingly consumed.

The spathic iron or carbonate of iron lick for some reason was not successful, and treatment was discontinued. A possible explanation for this, suggested by Mr. C. R. Taylor, is that insufficient care was exercised in selecting the boulders for grinding, so that the material may have contained very little iron carbonate, a contention that chemical analyses support.

In each group of fifty ewes twelve were selected for weighing at monthly periods throughout the duration of the experiment.

FIG. I. GROUP OF LIMONITE-TREATED EWES AND LAMBS.

Note good condition generally, and size of the lambs. Photo taken 14th January, 1932.

FIG. 2. GROUP OF CONTROL EWES (UNTREATED).

Most of the lambs of this group were dead when photo taken on 14th January.

At a farmers' field-day held on 20th February, a large number of farmers attending from Tokoroa, Waotu, Puketurua, and Putaruru, the following position was disclosed by Mr. C. R. Taylor, in charge of the experiment, and Mr. D. Marshall, Government Veterinarian stationed at Hamilton: All the lambs of the control group of ewes and the iron ammonium citrate group of ewes were dead. Of the

iron oxide group, forty-four lambs from forty-five ewes were an outstanding feature of the experiment, the ewes being particularly bright and healthy, while the lambs were well built, robust, with a healthy bloom on the wool, and gave the impression that they had come off good sheep-country. The total cost of this treatment, including oxide of iron and salt for the nine-months period was slightly over 5½d. per head. The control group, sixteen surviving ewes, were poor in condition and unthrifty. The iron and ammonium citrate group, twenty-four surviving ewes, showed an improvement over the control group, but were still much below the standard set by the iron oxide group. The cost of the treatment by citrate was slightly above 3d. per head. A post-mortem examination was made of two lambs. One from the oxide group, which killed out at 44½ lb., was in a perfectly healthy condition and entirely free from parasites. A lamb from the untreated mob, in rather poor condition, was killed and showed every sign of parasitic infestation, being " full of worms."

This experiment should establish the fact that healthy sheep can be reared from the Atiamuri type of country if this latest treatment is adopted. The cost of 5½d. per head will still leave the farmer with a satisfactory margin of profit. A fair inference from the post-mortem examination of the two lambs would be that the iron oxide treatment of the mother ewes had not only enabled their lambs to develop normally, but also to resist parasitic invasion. Treatment of the mother ewe is the secret of success, according to Mr. Taylor. Endeavour to treat the lambs has proved useless.

Thanks are due to Mr. T. V. Humphrey, manager of the property on which this experiment was carried out, and to Mr. E. A. Woodcock, one of his assistants, for making possible these lengthy trials with sheep, necessitating much careful attention on their part, which they have keenly given at all times.

The results of the experiment may be summarized as follows :—

Average Live Weight of Ewes at Commencement of Experiment (5th May, 1931, and again after Nine Months' Treatment (8th February, 1932).

—	5th May, 1931.	8th February, 1932.
	lb.	lb.
Limonite or oxide group ..	120	128
Iron ammonium citrate group ..	112	92
Control group (no treatment) ..	114	72

Lambing Percentages.

	At Birth.	When marked.
Limonite group	100	90
Iron ammonium citrate group ..	62	16
Control group	76	50

All the lambs of both the citrate and control groups were dead by the end of January, 1932. Only five of the limonite group have been lost, and these deaths were chiefly due to causes other than bush sickness. In one case only was there a suspicion of doubt, and in this instance death has been recorded as due to bush sickness.

The numerical strength of each of the respective groups under trial at the commencement of experiment (5th May, 1931) was fifty ewes, all of which had been on the property for not less than two years. Their ages varied between two and three years. The numerical strength and average weight of fleece of the same groups at time of writing (20th February) are as follows :—

	Number.	Weight of Fleece.
Limonite group	45	8½ lb.
Iron ammonium citrate group ..	24	About 7 lb.
Control group	16	6½ lb.

The cost of treatment per head of the two treated groups for nine months is as follows: Limonite group—2·8d. for limonite, and a similar amount for coarse salt; total, 5·6d. Iron ammonium citrate group—1·008d. for iron ammonium citrate, and 2·060d. for coarse salt; total, 3·068d.

It was found that owing to the flavour of the iron ammonium citrate the sheep would not voluntarily take it, when incorporated in a salt lick, in anything like the quantity necessary to keep them in health; hence the results obtained. With the limonite, which has no objectionable flavour whatsoever, no trouble was experienced from start to finish of the experiments, the sheep at all times taking it readily when and as required. For this reason it is to be recommended as an efficacious and practical treatment for cattle and sheep in those districts where past experience has demonstrated that drenching, &c., with iron ammonium citrate has given the desired results.

It is important to note that all groups have grazed the same set of paddocks in rotation, thus eliminating any possible suggestion that any particular group has been favoured in treatment (other than licks). For a number of years past 2 cwt. of superphosphate has been the only top-dressing used; last spring 2 cwt. of super and slag mixture (half-and-half) was applied instead. No liming has been done at any time.

The average live weight of the limonite-treated lambs works out at 78 lb., and the carcass weight at approximately 39 lb. on the hooks, which can only be regarded as a very fine performance viewed in the light of past experience on this property.

The lambs of all the other groups are now dead, so that comparable figures cannot be given for this period. The results, however, provide ample evidence of the efficacy of limonite as a means of keeping sheep, and later lambs, in a healthy condition on pumice country—hitherto found impossible.

Conversion of Paspalum Grassland. — The Instructor in Agriculture at Whangarei, North Auckland, reports as follows: "On several farms pastures have recently been brought to my notice where, by top-dressing regularly with phosphates, and improved grazing and harrowing, what were originally more or less root-bound paspalum fields have been converted to excellent perennial ryegrass, white clover, and paspalum pasture. The perennial rye is exceptionally strong in the early spring, and the question has been raised as to whether the paspalum will be able to hold its own. The quantity of feed produced in the summer is said to be less than in past seasons, and it would appear possible for the strong growth of perennial rye to thin out the paspalum to such an extent that its production would fall off."

ORCHARD SPRAYS IN NEW ZEALAND.

I. THE SULPHUR SERIES.

G. H. CUNNINGHAM, Mycologist, Plant Research Station, Palmerston North.

THIS is the first of a series of articles covering the orchard sprays in commercial use in New Zealand. The articles are based on information secured as the result of recent investigations conducted primarily to obtain data for framing the regulations necessary to make operative the Fungicides and Insecticides Act of 1927. The object of the present paper is to discuss the available types of sulphur, to indicate their respective values, the unit by which such values may be assessed, the manner in which sulphur acts as a fungicide, &c.

HOW SULPHUR ACTS AS A FUNGICIDE.

Although sulphur has been used as a fungicide since 1846 (in which year it was introduced in England to combat the mildew of grape-vines), it has only comparatively recently been introduced into orchard practice. In New Zealand it was first used about 1916 to combat powdery-mildew and black-spot of apple-trees, and more recently, alone or in the form of the so-called "dry mix," as a controllant of brown-rot and leaf-rust of stone fruits. Although this material has been in use for a longer period than any other spray, it must be admitted that even to-day the manner in which it acts is but imperfectly understood. Numerous theories have been published, and the fungicidal action of sulphur has been attributed to many compounds which it is capable of forming when combined with oxygen or hydrogen. Thus, writers have held that its toxicity was due to the production of gases such as sulphur dioxide or hydrogen sulphide; to the production of sulphurous, sulphuric, thio-sulphuric, or pentathionic acids; or due to the fact that it acted directly either in the form of finely divided particles or as sulphur vapour.

From a consideration of the experimental data presented it is probable that the following approximates to an accurate explanation of the toxicity of this element. It would appear that when sulphur is applied to a plant it gives off continuously either minute solid particles (Barker, 1928), or, what is more probable, a volatile gaseous sulphur (Goodwin and Martin, 1928; McCallan and Wilcoxon, 1931). This vapour (or these particles) is diffused through the air and deposited upon spores or hyphæ of fungi in the vicinity, as well as upon host-plant tissues, and there condensed to solid particles of sulphur. According to Goodwin and Martin (1929) it is these minute particles which are toxic to fungi to which they have been applied; but Barker (1928, 1930) and McCallan and Wilcoxon (1931) consider that these particles are converted into hydrogen sulphide, which acts as the toxic agent. Barker (1930) thought that conversion of these minute particles into hydrogen sulphide was effected upon the exterior of the fungus (or host plant) by means of a substance emerging from the tissues; whereas McCallan and

Wilcoxon (1931) held that conversion occurred within the tissues. In both reduction was considered to be of an enzymic nature. It has been convincingly shown by the experiments of Marsh (1928), Barker (1928, 1930), and McCallan and Wilcoxon (1931) that the gas hydrogen sulphide is toxic to fungi (and, in lesser degree, to the host-plant tissues) as was demonstrated first apparently by Pollacci (1875) upwards of half a century ago.

Factors affecting the Fungicidal Efficiency of Sulphur.

Recent investigations have shown that the fungicidal value of a sulphur may be measured by the size of the particles of which it is composed. Thus Young (1922), Wilcoxon and McCallan (1930), and Goodwin, Martin, and Salmon (1930) have shown that the toxicity of a sulphur is increased as the size of the sulphur particles is decreased. This may be due to the fact that the smaller the particles the greater the surface area, with a consequent increase in the quantities of sulphur vapour produced by a given amount of sulphur. There is also a definite correlation between the size of the sulphur particles and the quantity which remains upon fruit and foliage after application. For Fitch (1925) found that from 40 to 64 per cent. of a dusting sulphur was lost shortly after application; and Thatcher and Streeter (1925) showed that when a sublimed sulphur was applied from 89 to 94 per cent. was lost within one week of application. In this Laboratory it has been found that whereas the majority of the particles of a sublimed sulphur had disappeared from leaves sprayed four days previously (save those caught in leaf-hairs or lodged in crevices), leaves sprayed with a colloidal sulphur were found to be coated with a continuous film of particles, which were not dislodged when leaves were sectioned for examination. From an examination of leaves sprayed with different sulphurs it is evident that particles of a size in excess of 50 microns (this term will be explained below) fail to adhere to foliage for more than four days, the majority disappearing within a few hours of application.

The practical significance of this is that the smaller the particles the greater the amount of sulphur which will remain on a tree for a given time, permitting of a reduction in the quantities of the finer sulphurs that need be applied.

Efficacy of a sulphur may be affected by the degree of coverage secured; thus it is possible that the greater efficacy of a colloidal sulphur over a sublimed or ground sulphur is due to the fact that with the former a continuous film of particles is deposited over the leaf or fruit surfaces, whereas with the latter the particles, at normal dosages, are somewhat widely scattered.

The size of the particles likewise plays a part in the practical application of sulphur sprays. Mixed with water only the finest of sulphurs will remain in suspension for more than a brief period, the others requiring constant agitation to prevent the particles settling in the spray-tank. This is significant, as where stationary power plants are in operation there is danger of blockage of pipe-lines, where these are at all long, when coarse sulphurs are used.

MEASUREMENT OF SULPHUR PARTICLES.

As has been shown, the value of a sulphur as a spray may be measured in terms of the size of the particles of which it is composed. For this purpose the following four methods have been used:—

(1) *Sieving.*—In the United States of America sulphurs are offered for sale on the basis of their being able to pass through certain sieves, 200- and 300-mesh sieves being regarded as standard for dusting and spraying purposes. Such sieves require that particles shall be of a theoretical size of not more than 74 microns for the 200 mesh, and about 47 microns for the 300 mesh. Actual measurements of samples of all commercial sulphurs on the New Zealand market have shown that the sizes of maximum particles range between 125 and 175 microns, quite 60 per cent. of the most finely ground being above 50 microns. It is evident therefore that there is little if any correlation between the sieve standards and the commercial materials offered on this market. Tests have shown that it is extremely difficult to pass even small quantities of a ground sulphur through a 200-mesh sieve, and practically impossible to use the finer series, which precludes the practical application of this method of measurement.

(2) *Chancel Test.*—In this a given quantity of sulphur (usually 5 grammes) is placed in a vessel, termed a Chancel tube, which is calibrated into one hundred divisions, each representing a "Chancel degree." To the tube is then added a given quantity of anhydrous ether. The mixture is then shaken and the sulphur allowed to settle, when its height in the tube is read in terms of degrees. The higher the reading the better the sulphur is supposed to be as a fungicide. Actual tests conducted in this Laboratory have shown that these Chancel degrees bear no relation to particle size, the best readings being secured with sulphurs in which the particles are aggregated into coarse groups. Consequently the process is worthless as a measure of the efficacy of sulphurs for spraying purposes.

(3) *Sedimentation Test.*—This is based on the assumption that particles of sulphur of different sizes have different periods of settlement.

The following method has been used in attempts to measure the relative fineness of colloidal sulphurs. Into glass cylinders are introduced measured quantities of the sulphurs, and equal amounts of water added to each. The vessels are then agitated until complete suspension has been secured, and are then placed side by side, and the contents allowed to settle, the rate of settlement of each being measured at periodic intervals. Success is possible only if no protective colloid is present (substances, such as glue, added in small quantity to hold particles in suspension for a prolonged period), for the presence of such in any sample would prevent measured results from being secured, and moreover would be difficult to detect by analysis. It is noteworthy that protective colloids are usually used during the preparation of these sulphurs.

We have recently applied this test in modified form to measure the relative percentages of coarse and fine particles of ground and

sublimed sulphurs. In this process (which is still in the experimental stage) a given quantity of sulphur is mixed with a measured volume of water to which has been added a small quantity of soap solution to act as a wettable agent. After being agitated until all material is in suspension, each vessel is placed upright and the particles allowed to settle for a given time, when the water (containing the finer particles of sulphur) is pipetted off and placed in a second container. The process is repeated, varying degrees of fineness of particles being secured by varying the times of sedimentation. The precipitates are then dried and the sulphur content obtained by weighing. The method has so far proved reasonably reliable, since particles of these types of sulphur are usually too large to be affected appreciably by any colloid which may be present in the suspension. By applying the method to a commercial ground sulphur we have ascertained that between 60 and 70 per cent. of the particles are of a size in excess of 50 microns; and with a commercial sublimed sulphur between 85 and 90 per cent. were found to be in excess of this figure.

(4) *Microscopic Measurement.*—The use of the microscope in determining the relative sizes of particles of sulphur has not yet become general, since it is only recently that the significance of particle size has been demonstrated. But consideration of the available processes has shown that this is the only means at hand whereby the size of the particles of all types of sulphurs on the market may be gauged with any degree of accuracy, so that it is probable that this method will play an important part in future analyses. After making a study of all sulphurs offered for sale in New Zealand, I believe that by the aid of the microscope it is possible to segregate these sulphurs into groups upon certain characteristics described below.

The microscope shows that sublimed and ground sulphurs exhibit a great range in particle size. As it is not possible to average these, measurements must of necessity be given in minimum and maximum figures. Further subdivision of the sizes of the particles may be undertaken, if required, by the sedimentation test. As the unit of microscopy is the micron (which equals $\frac{1}{1000}$ of 1 millimetre, or about $\frac{1}{25000}$ of 1 in.) all measurements herein are expressed upon this scale.

Classification of Sulphurs.

Microscopic analysis of the commercial sulphurs available shows that it is possible to group them under the following four headings:—

(1) *Ground Sulphur.*—This sulphur, sometimes termed flour sulphur, is prepared by mechanical grinding of refined roll or lump sulphur. The characteristics of such a sulphur, as defined herein, are that the particles are in the form of crystals with definite cleavage angles, and are pale yellow and translucent in transmitted light. Whatever their size, they remain distinct from one another, and do not become massed into groups. The particles exhibit great diversity of size (Fig. 1), the minimum being as low as 4 microns, and the maximum in the vicinity of from 125 to 250 microns, according to the grade of the sample.

FIG. 1. PHOTOMICROGRAPH OF A GROUND SULPHUR. × 130.
Note crystalline nature of particles.

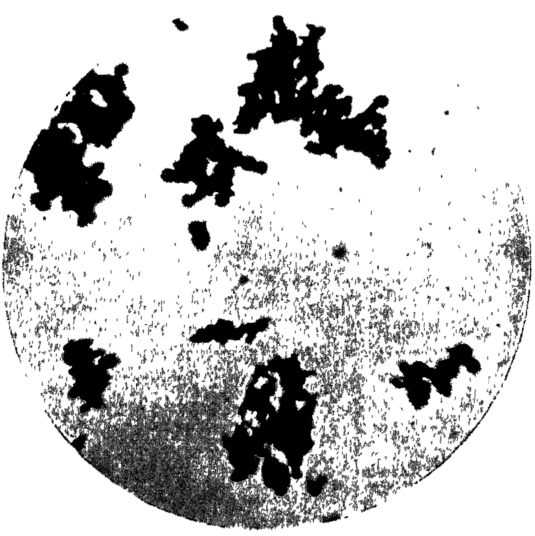

FIG. 2. PHOTOMICROGRAPH OF A SUBLIMED SULPHUR. × 130.
Note manner in which particles are agglutinated into masses.

[Photomicrographs by W. D. Reid.

Sulphurs of this type are usually applied at the rate of from 10 lb. to 12 lb. per 100 gallons of water.

(2) *Sublimed Sulphur.*—This material, commonly known as flowers of sulphur, is prepared by a process of sublimation. Sulphur or ore containing such is roasted in a furnace, and the vapour produced is led through flues into chambers where it is condensed by cooling and the sulphur deposited. Theoretically, such a sulphur is composed of rhomboid crystals, but in all commercial samples examined the particles were found to be more or less spheroidal, opaque, and firmly cemented into chains or irregular masses (Fig. 2). These aggregates vary greatly in size and shape, being from 150 to 400 microns across, and the particles of which they are composed when dissociated are between 8 and 30 microns. When such sulphurs are passed through a spray-pump, the masses do not break up to any appreciable extent, as has been demonstrated in this Laboratory by passing given quantities through a spray-pump (under a pressure of 100 lb.) on to sheets of paper, and examining these subsequently under the microscope. The fact that such a sulphur is largely composed of coarse particles, which precludes their remaining upon the leaf surface for any time, explains why sublimed sulphurs have proved relatively ineffective as controllants of black-spot and powdery-mildew in New Zealand.

Sublimed sulphurs are applied at rates comparable with ground sulphurs—namely, from 10 lb. to 12 lb. per 100 gallons.

(3) *Precipitated Sulphur.*—Under this heading are included certain sulphurs which occupy an intermediate position between the two just discussed and the colloidal series. Several have been offered for sale under the trade names of milk of sulphur, precipitated sulphur, or flotation sulphur. Their characteristics, as defined herein, are the size of the individual particles (2 to 12 microns), their crystalline translucent appearance, and the characteristic manner in which they tend to agglutinate into groups 200 microns or more across, which appear under the microscope not unlike snow or frost crystals (Fig. 3).

Sulphurs of this type are prepared by chemical precipitation, several methods being available, such as (*a*) by treating sodium thiosulphate with sodium bisulphate in the presence of glue; (*b*) by adding a saturated solution of sodium thiosulphate to concentrated sulphuric acid; or (*c*) by treating a solution of commercial lime-sulphur with sulphuric acid. Considerable confusion exists in literature as to the differences between these sulphurs and the colloidal series, as several prepared by chemical precipitation are called colloids. Materials prepared by the three processes mentioned are seen under the microscope to show the characteristic features of precipitants.

Precipitated sulphur has proved most disappointing when tested under field conditions, showing little if any improvement over ground or sublimed sulphurs. The probable reason for this is that the particles form aggregates which are too large to remain on the tree, since we have demonstrated that they are about 200 microns across and not broken up to any extent by passage through the spray-pump. This material is usually applied at between 6 lb. and 8 lb. per 100 gallons.

FIG. 3. PHOTOMICROGRAPH OF A PRECIPITATED SULPHUR. X 130.
Note crystalline particles agglutinated into masses.

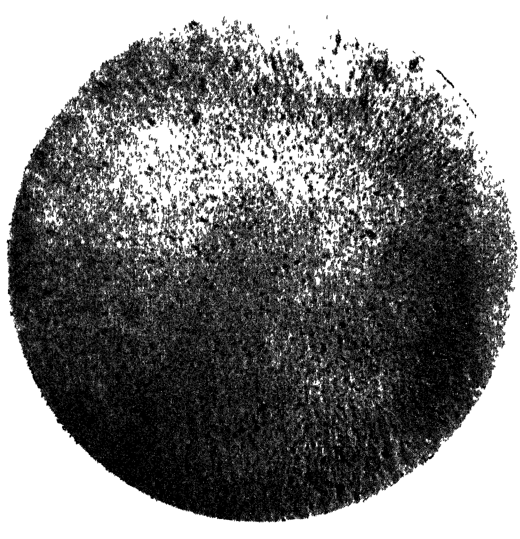

FIG. 4. PHOTOMICROGRAPH OF A COLLOIDAL SULPHUR. X 600.
Note the exceedingly fine particles and the manner in which they are dissociated. Only the larger particles are visible in this illustration.

[*Photomicrographs by W. D. Reid.*

(4) *Colloidal Sulphur.*—This name is applied to a group of sulphurs characterized in that the particles of which they are composed are mostly spheroidal in shape, of exceedingly fine dimensions, and do not aggregate, but remain dissociated (Fig. 4). The particles range in size from a small percentage of grains about 3 to 4 microns to ones so minute as to be beyond the limits of accurate measurement; the majority average between 0·5 and 1 micron.

This type of sulphur was introduced into the Dominion on a commercial scale only last season, but has been successfully used in Britain for the past three or four years, and is said to have largely displaced the coarser sulphurs in Europe. The name is rather unfortunate, since these materials are not colloids, but suspensions of minute particles of sulphur in water. The methods of preparation are trade secrets, and therefore not available; but it is probable they are prepared by electrical precipitation followed by grinding, in the presence of a protective colloid, in colloid mills of the Plauson type.

Colloidal sulphurs are recommended at from 2 lb. to 4 lb. per 100 gallons of water, on a basis of their containing 50 per cent. of sulphur in the concentrate.

The relative sizes of the particles of these four types of sulphurs may be summarized by the following table:—

Type of Sulphur.	Size of Particles. Minimum.	Size of Particles. Maximum.
	Microns.	Microns.
Ground*	4–8	125–250
Sublimed*	8–30	150–400
Precipitated	2–12	200
Colloidal	0·1†	4

* The maximum size of particles of these coarse sulphurs is governed by the grade of the sulphur under test, the figures given being secured from so-called 200- and 300-mesh samples.

† This figure is approximate, since it is not possible to measure accurately below about 0·25 micron.

Water Content.

Certain sulphurs are offered for sale in paste or fluid form. The advantage is that they can be mixed readily with water, but the disadvantage is that the sulphur content may vary in different brands, and thus upset the correct proportion of application. Consequently it is a matter of importance to the grower that he should know the water content of any brand, so that he may apply the recommended quantity of sulphur.

Wettable Agent.

As sulphur particles cannot be mixed readily with water it is customary to add to prepared spraying materials substances which will overcome this difficulty. Such treated sulphurs are known as wettable sulphurs. For this purpose any one of many substances (among which may be mentioned kaolin, calcium caseinate, glue, gelatine, soap, diatomaceous earth, hydrated lime, or alcoholic solutions of oleic acid) may be added to the sulphur in order to overcome the surface tension of the water sufficiently to enable a satisfactory suspension to be secured. As there is a possibility of reaction between

certain of these and other sprays with which the sulphur may be mixed, it is advisable to know the nature and percentage of the material used.

USES OF SULPHUR SPRAYS.

In New Zealand sulphur sprays have been used since 1916 in the control of black-spot and powdery-mildew of apples, and since 1925 against brown-rot and leaf-rust of stone fruits. Until this last season only ground and sublimed sulphurs were used on a commercial scale, their use in recent years becoming general owing to a belief among orchardists that their addition to lime-sulphur tended to reduce the scorching and russetting effect of the latter on leaves and fruits. Precipitated sulphur was used to a lesser extent, since its high price and relative inefficiency compared it unfavourably with ground or sublimed sulphurs.

Experiments conducted in various parts of the Dominion during the past two seasons (particulars of which will be published at a later date) have shown that ground and sublimed sulphurs give partial control of black-spot, but have practically no effect upon powdery-mildew. Somewhat comparable results were secured with precipitated sulphur.

With colloidal sulphurs, on the other hand, outstanding results have been secured, for not only has this material (at 4–100) proved about equal to lime-sulphur as a controllant of black-spot, but it has given decidedly superior results in combating powdery-mildew. During the past season a commercial colloidal sulphur at the reduced strength of 2–100 gave almost complete control of powdery-mildew in one locality where lime-sulphur failed to hold it in check. The most outstanding results have been secured with a combination of colloidal sulphur and lime-sulphur (lime-sulphur 1–200 plus colloidal sulphur 2–100), this combination effectively controlling powdery-mildew, holding red-mite in check, and producing fruit noticeably free from russet.

ACKNOWLEDGMENTS.

I am indebted to Mr. W. D. Reid, of this Laboratory, for the microphotographs of sulphurs reproduced; to Mr. J. D. Atkinson for conducting work in connection with applications of sulphur to leaves, and estimations of percentages in different precipitation tests; to Mr. W. K. Dallas, for data concerning the field experiments; and to Mr. R. L. Andrew, Dominion Laboratory, Wellington, for information regarding British and American sieve standards.

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HARD-FERN CONTROL BY SPRAYING WITH ARSENIC PENTOXIDE.

EXPERIMENTAL WORK IN CONNECTION WITH REGRASSING SECONDARY-GROWTH COUNTRY AT WHANGAMOMONA.

E. BRUCE LEVY, Agrostologist, and E. A. MADDEN, Assistant in Agrostology, Plant Research Station, Department of Agriculture, Palmerston North.

HARD-FERN (*Paesia scaberula*) is an indigenous weed common on hill country where the annual rainfall is 60 in. or over. It is essentially an induced weed, being in this respect similar to the indigenous piripiri (hutiwai) and the useful native grass Danthonia pilosa.

The spread of these three New-Zealanders may be regarded as induced by the grazing animal, which by controlling all top shade-making growths allows the free access of light to the soil-surface that favours their establishment and spread. Close and continuous grazing, particularly by sheep, and the absence of a good sward of grass, favour alike hard-fern, piripiri, Danthonia pilosa, and, in the country under review, the indigenous manuka as well. Danthonia pilosa is a highly desirable grass on the country here dealt with ; piripiri can be controlled by judicious stocking with cattle ; manuka control lies in the use of the slash-hook and the firestick, or by hand-pulling in the young stages. Hard-fern may be controlled to some extent by periodical spelling and cleaning up by cattle as in the case of piripiri ; when in large clumps it may be partially removed by burning ; and these methods undoubtedly are the most practical for dealing with large areas and where the country is difficult.

In what follows it is not expected that spray treatments will supersede stock manipulation methods nor burning on a large scale, but up to the present the writers know of no areas in Whangamomona County which have been entirely cleared of hard-fern once those areas have carried a strong growth of it. There are areas which have been kept free of hard-fern from the time of initial burns

that took place upwards of thirty years ago, before the surface of the country was impregnated with hard-fern spores, but cases are rare of complete control after a bad infestation of the hard-fern growth. The hard-fern may be a phase in the development of this 60-in.-and-over rainfall belt, but the phase is seemingly a long one, and particularly so under sheep grazing rather than cattle. The formation of a dense sward of persistent grasses and clovers is having a big steadying-up effect on the spread of hard-fern, and we are of the opinion that once a dense sward can be secured, and once the ground-surface ages and becomes weathered and dried, there is not the same chance for re-establishment of the fern from spores that may be blown in from neighbouring country.

A dense sward of the hardy grasses can only be secured provided the spread-back of the hard-fern is prevented, and burning the fern reproduces a young soil-surface as against an old, matured soil-surface, thus making possible again re-establishment of the fern from shed spores. For the complete elimination of the ring of growth left after the burn, and for those small centres of reinfestation remaining where the rhizomes were too deeply buried to be killed by the heat of the burn, and for the control of sporelings that appear in the shady aspects, crevices, &c., until the burnt surface matures and ages, some effective method of killing the fern is highly desirable. Then, again, shady faces, where effective burns can scarcely ever be secured, and for those patches too small to carry a fire, pre-killing of the fern growth by spraying makes possible an intensely hot burn that is as efficient when on the shady slope as on the sunny slope.

THE WHANGAMOMONA EXPERIMENTS.

Arsenic pentoxide has been experimented with during the past five years at Whangamomona, and the results are sufficiently encouraging to place the spray pump as an additional effective implement for control of this troublesome secondary growth on hill country.

The first area sprayed was on the farm of Mr. A. Coxhead in the autumn of 1926, and a trial strength of 1 lb. of arsenic pentoxide to 30 gallons of water was used.* This strength gave almost complete control of the hard-fern on the small area sprayed. In the autumn of 1927 an area of approximately 20 acres was treated, using a spray strength of 1 lb. arsenic pentoxide to 32 gallons of water (1–320 formula). In the succeeding year trial strengths and monthly spraying trials throughout the entire twelve months were carried out for the purpose of deciding the most economical strength of the arsenic pentoxide to use and the best time of the year for the application.

For these trials a badly infested area was divided up into ¼-acre blocks and sprayed at the following strengths: 1–120, 1–180,

* Arsenic pentoxide is poisonous to stock, and in the initial stages of the investigation it was not known what danger attended the spraying. We wish specially to thank those farmers who took a certain amount of risk in placing fern-infested paddocks at our disposal for treatment, particularly Messrs A. Coxhead, J. McCluggage, A. Perry, and W. Gill.

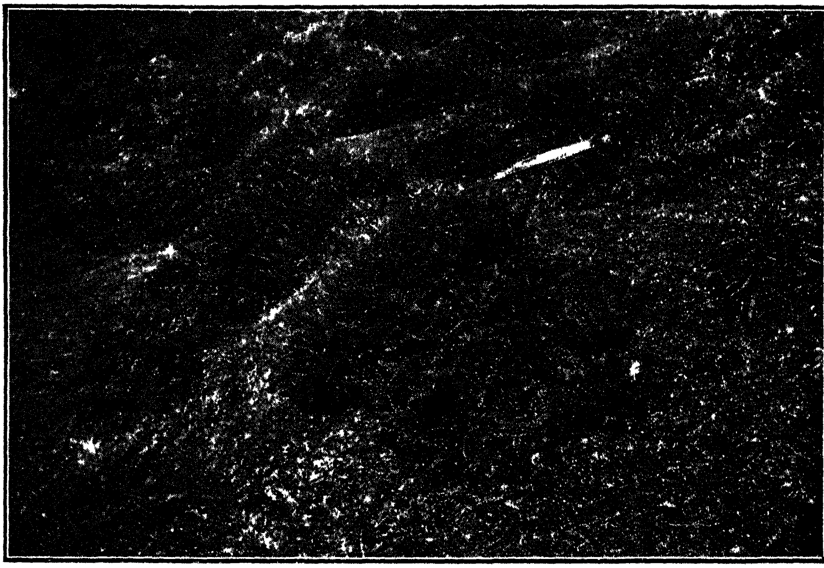


FIG. 1. AREA OF HARD-FERN BURNT AND SOWN IN 1926, AND PHOTOGRAPHED FOUR YEARS LATER.

Showing return of hard-fern despite the fact that a fair sward of brown-top, Lotus major, and danthonia was secured. Experiments with poison-spray materials were inaugurated in 1926 to kill ring-edge and small centres of infection left after the burn.

FIG. 2. SPRAYING HARD-FERN WITH ARSENIC PENTOXIDE ON AN EXPERIMENTAL AREA.

The Vermorel knapsack type of spray-pump is quite suitable for the work, using the fine double nozzle and a good pressure. After being sprayed this area was burnt and sown, and is now, three years later, virtually free of hard-fern.

[*Photos by E. Bruce Levy.*

1–240, 1–300, 1–360, 1–480, 1–560, the foliage in each case being well wetted by the spray. All of these strengths were effective in browning off the fern, and any one area could have carried an intensely hot fire that would have killed any newly developed fronds which had not put in an appearance at the time of spraying. All plots, however, were left unburnt for a full year in order to study subsequent return of fern. The two lighter treatments and the two heavier treatments showed most return growth. This can be explained on the assumption that in the case of the lighter strengths insufficient material was applied to poison effectively, while in the case of the strong solutions immediate contact kill was effected of all parts wetted by the spray, and thus no intake into the sap system of the plant was secured.

This is in accord with numerous poison-spray experiments with plants. Instant-contact kill of foliage sprayed brings about a condition almost synonymous with burning or cutting, in which little or no damage is done to the sub-aerial or root-stock portion of the plant. If just sufficient spray material can be put on to kill the plant gradually the intake of the poison into the system of the plant is secured, and death of root-stock as well as of foliage sprayed results. The practical difficulty, however, in making use of this knowledge is to know how to apply sufficient poison in a sufficiently dilute solution to effect this. In order to penetrate the outer cuticle of the plant moderately strong solutions are necessary, and these, once penetration is effected, kill the tender conducting tissues, so that these are no longer effective as a vehicle of transportation of the poison to the underground root-system.

The weaker strengths used in the trials—the 1–480 and 1–560—are sufficiently strong to kill enough fern fronds to enable a very hot burn to be secured, but they are not effective in killing patches too small to burn. The strength that has given the best results is the 1–320 formula (1 lb. arsenic pentoxide to 32 gallons = 320 lb. of water). Every portion of the hard-fern plant wetted with this strength solution will die.

Directions for Preparation of the 1–320 Spray.

Arsenic pentoxide is soluble in cold water. The required amount of arsenic pentoxide is best dissolved in a moderately small quantity of water and then diluted down to the required strength. The following is a convenient plan :—

Stock solution : Dissolve 1 lb. of arsenic pentoxide in 2 gallons of cold or luke-warm water. Boiling water should not be used, as this decomposes the arsenic pentoxide.

Spray solution : Take 1 quart of stock solution and add this to 3¾ gallons water, thus making 4 gallons of solution ready for spraying. Spraying is best done with a knapsack spray-pump of the Eclair Vermorel type, using the fine double nozzles. A good pressure in the pump ensures a finer spray and a more even distribution of the poison. The fern should be well wetted all over, care being taken to spray the edge of each patch well. The fern foliage must be dry prior to spraying, which should be done only in fine weather.

Precautions : As arsenic pentoxide is poisonous all stock should be removed from the paddock being sprayed and kept off for a week or

FIG. 3. HARD-FERN AND SOME TUPARI FERN COMING AWAY ON A DAMP SLOPE, TWELVE MONTHS FOLLOWING THE BURN AND SEEDING-DOWN.

Lotus major is here well established, and provided the hard-fern can be destroyed will effectively cover this slope.

FIG. 4. A SIMILAR ASPECT TO THAT SHOWN IN FIG. 3, WHERE THE HARD-FERN HAS BEEN KILLED BY SPRAYING.

The Lotus major is seen making new growth through the dead fern-fronds.

[*Photos by E. Bruce Levy.*

until rain. It is inadvisable to immerse the hands in the solution, particularly in the stock solution, and leaky pump-hose or taps should be remedied. Constant wetting of the hand leads to painful injury of the quick of the nail. Arsenic pentoxide absorbs moisture from the air ; the material should be kept in airtight tins, and the lid replaced when any weighing out has been completed. The strength of the stock solution or any solution weakens on keeping, and only sufficient for the day's work should be made up at any one time. Arsenic pentoxide does not corrode the spray pump, but this and all tins should be well rinsed with water after use.

Time of the Year to Spray.

The results of monthly applications of spray throughout the twelve months of 1928 indicated that, provided fine weather conditions prevailed at the time of spraying and for twelve hours following, all fern fronds were killed and all areas sprayed during the year burnt clean in the autumn of 1929. The most return growth took place on those areas sprayed in winter and early spring, and where the objective is to get a 100-per-cent. kill of isolated small clumps that cannot afterwards be fired spraying is best done from beginning of December to the end of April. Where burning and autumn seeding is to be done following the spray, some three to four weeks should elapse after spraying before the area is fired. Thus all areas to be burnt and sown should be sprayed by the end of February. It must be borne in mind, however, that where an area is sufficiently dense to carry a good fire spraying before the burn is not recommended, except in damp hollows or shady slopes.

After the fire very much less material and labour is required to spray the small unburnt patches and rings that are left where isolated clumps are burned. One spraying is seldom sufficient to get a 100-per-cent. kill, for despite every care some small patches will be missed or inadequately sprayed the first time over. On most of the areas treated two sprayings have resulted in practically 100 per cent. kill, and from our experiences to date it will be a matter of three to four years before a further spraying will be necessary. The first areas sprayed in 1926 to 1928 are still practically free of hard-fern.

Economics of the Practice.

The first two years' work proved the efficacy of the spray method of dealing with hard-fern, but some years will be necessary before the economics of the practice can be gauged at all accurately. Approximately 170 acres of country have been experimentally treated at Whangamomona, and of this 72 acres have had two applications of spray. The relative cost of the material is very low, and 1s. per acre may be put down as a conservative figure. The main cost is the labour and the packing of water on to the area. Given a good pack-horse, and with water moderately handy, two men should do 4 acres in one day.

On one area four men working for seven days of about six hours and a half each did approximately 50 acres of moderately infested country and used for this area 28 lb. of arsenic pentoxide. On another area of 11 acres, spraying return growth three years after burning and sowing took one man thirteen days, and 11 lb. of arsenic pentoxide was used. Water on this area was difficult of access, and too much time was taken

FIG. 5. SMALL ISOLATED HARD-FERN PATCH ON A BARE SLOPE EFFECTIVELY KILLED BY SPRAYING WITH ARSENIC PENTOXIDE.

Without spraying it is impossible to deal with these small clumps until they have spread and occupied a considerable area.

FIG. 6. HARD-FERN BURN (NOT SOWN) SHOWING SMALL CENTRE OF THE FERN WHERE THE FIRE WAS NOT SUFFICIENTLY HOT TO KILL ALL RHIZOMES.

Below may be seen two sporelings of hard-fern. Spraying at this stage kills 100 per cent. of these small fern-growths.

[*Photos by E. Bruce Levy.*

up in packing. In a small rather heavily infested paddock of 6 acres 15 lb. of arsenic pentoxide was used, and it took one man three days to spray this area. The area was burnt and sown, and some months later gone over a second time, when less than ½ lb. of arsenic pentoxide was used and two hours completed the work. At the present time, four years later, this area is practically free of hard-fern. A 5-acre block burnt and sown in 1924 and reburnt in 1928 was sprayed twice, once soon after the 1928 burn and again in May of the same year. Eleven pounds of arsenic pentoxide were used over the two sprayings, which took two men eight days. Practically no hard-fern showed on this area at the end of 1931, as may be seen by reference to Fig. 7 on page 86 of last month's *Journal*. A lighter infested area of 20 acres took 10 lb. arsenic pentoxide for two sprayings—8½ lb. for the first time over and 1½ lb. for the second treatment—and the time taken was eleven days for one man.

Haulage of water is one of the main considerations, and if some means of water storage on hill country to be treated could be devised the greatest objection to this method of control would be overcome. Given water handy, spraying with a knapsack spray-pump on hill country is not exceedingly laborious.

It will be obvious from the foregoing examples that the labour cost far exceeds that of the material. On the type of country and stage of fern growth where spraying is recommended, the per-acre cost for material should not exceed 1s. As regards labour, this hill-country spraying may have to be included with many other jobs on the farm that cannot be reckoned at so much per hour of the farmer's time.

"NUTRITION ABSTRACTS AND REVIEWS."

AGRICULTURAL scientific workers in the British Empire have in the past two years been brought into closer touch one with the other than ever before by means of Imperial bureaux attached to a Central Council on which sit representatives of various parts of the Empire and from the bureaux. As each bureau becomes established it is issuing précis of all published papers coming within its particular scope. In the case of the Bureau of Animal Health and the Bureau of Animal Nutrition these have become regular publications, the former named the *Veterinary Bulletin* and the latter *Nutrition Abstracts and Reviews*.

The first issue of *Nutrition Abstracts and Reviews*—issued under direction of the Imperial Agricultural Bureaux Council, Medical Research Council, and the Reid Library—which came to hand recently, is a paper-covered volume of 351 pages, together with an authors' index. It is edited by Dr. J. B. Orr, who is in charge of the Rowett Institute, Aberdeen, Professor J. J. R. McLeod, of Aberdeen University, and Dr. Hariette Chick, of the Lister Institute, London, together with a number of assistant editors. Four hundred and fifty periodicals are reviewed, and papers of interest are extracted and summarized. The *Journal* commences its service with literature published in January, 1931. Papers abstracted take in all phases of nutrition in animals and in man, and consequently there is bound to be some overlapping of subjects dealt with by other bureaux. The editors have arranged subjects in sections dealing with technique, composition of foodstuffs, physiology of nutrition, dietetics, feeding of animals, and diet in relation to health and disease. Also included are reviews by men thoroughly versed in the subjects dealt with, and it is intended in such reviews to give bibliographies. The annual subscription is 21s.

The New Zealand representatives of the Bureau of Animal Nutrition are Dr. J. Malcolm, Professor of Physiology, Medical School, Dunedin, and Mr. B. C. Aston, Chief Chemist of the Department of Agriculture, Wellington.

DISTRIBUTION OF MEDULLATED FIBRE IN NEW ZEALAND ROMNEY FLEECES.

FLEECE-SAMPLING FOR THE BENZOL TEST.

B. L. Elphick, B.Sc., Massey Agricultural College, Palmerston North.

In February, 1931, the writer discussed in this *Journal*(1) the nature and significance of the medullated fibres which are present in the fleeces of so many of the Romney flocks of New Zealand. It was pointed out that although it is only the strongly medullated or really hairy fibres that are distinctly objectionable to the textile manufacturers, yet the finely medullated fibres, difficult or impossible to detect by the naked eye, are almost as undesirable from the breeders' point of view, since they represent a taint in the blood which is liable to be perpetuated and intensified in the flock if not culled out.

There is sufficient breeding experience to support the statement that strong medullation is largely hereditary in its nature, so that it can be bred out by selection; and there is every reason to suppose that this applies equally to slight medullation. These are points, however, which have not yet been settled conclusively by scientific investigation.

The new benzol test which makes simple and infallible the detection of even the slightest trace of medullated fibre in a staple, was then described; and in May, 1931, details of a simplified wool-testing equipment, suitable for use on the farm, were published(2). Full details and precautions for carrying out the test were given, so that breeders themselves could make use of the new method of examination in selecting their breeding-stock.

It should be noted that medullated fibre is produced by all our common breeds of sheep, even the Merino, and that the benzol test is applicable as an aid in the selection of all these breeds. It is satisfactory to be able to report that already about 150 stud-flock owners have availed themselves of the arrangements made by Massey Agricultural College to supply complete outfits for the carrying-out of the test.

It was also recorded(1) that the first fleece examinations made by means of the benzol test disclosed the quite unexpected fact that adjacent staples frequently differ to an extraordinary extent in their degrees of medullation. So much so, that a few isolated medullated staples may sometimes be found in an otherwise non-medullated part of the fleece, and *vice versa*. Furthermore, although it was generally known that medullation is more pronounced in the britch than elsewhere, no definite information had ever been published, so far as the writer was aware, on the mode of distribution of medullation over the Romney fleece as a whole. Attention was drawn to the difficulties arising from this source, but no recommendations for sampling could then be made.

It will be obvious that a fleece cannot be judged from the nature of one staple alone, and that in order to use the benzol test for ascertaining the relative merits of two fleeces, as regards their content of medullated fibres, one must be able to obtain a truly representative

sample of each fleece in as small number of staples as possible. The question that immediately presents itself is: How many staples must be taken from a fleece, and from which parts, in order to obtain a satisfactory sample of the fleece?

EXPERIMENTS ON THE DISTRIBUTION OF MEDULLA IN THE FLEECE.

Experiments have been conducted with a view to answering the above question. The first essential was to ascertain as exactly as possible the manner in which medullation disposes itself over the fleece; and as this involves an extremely detailed examination of each fleece studied, it has not yet been possible to extend this examination to a large number of fleeces.

The following results refer to the fleeces of seven Romney crossbred ewes, selected more or less at random from the college flock. Four were sampled in November, 1930, as hoggets, and three in September,

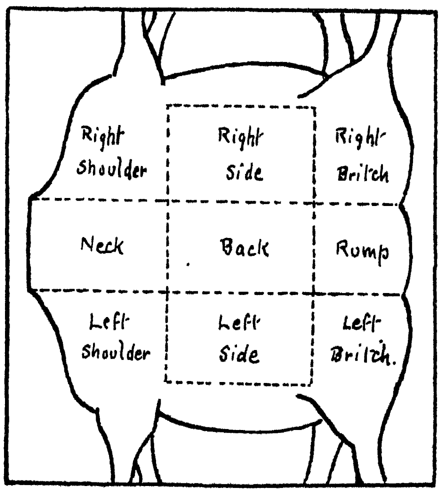


FIG. 1. SHOWING MODE OF DIVISION OF FLEECE INTO AREAS FOR SAMPLING.

1931, as two-tooth ewes. The term "more or less at random" is used because it was necessary, before a very detailed examination was embarked upon, to ensure, by means of a preliminary rough survey, that each animal selected had a reasonable amount of medullated fibres in its fleece. Apart from this no conscious selection of the animals used for the experiment was made. A further fifteen fleeces have been sampled in extreme detail this season, but their examination is being deferred pending the development of a better means of assessing the results.

For convenience each fleece was divided into nine roughly similar areas. The hip bones were used as points of reference, and vertical and horizontal lines were drawn from these points. The mode of division is illustrated in Fig. 1.

Each area was then sampled separately, as many in some cases as thirty-six staples, but never less than twelve staples, being cut from

evenly distributed and carefully noted positions within each area. Each staple was labelled and packed separately. Such complicated sampling as this is, of course, necessary only for the purposes of such experiments as these. The detailed and exact information thereby gained is needed to furnish a reliable basis for the very much simpler method of sampling recommended below for ordinary fleece-examination. The technique of sampling will be dealt with in a subsequent article.

Each staple was then tested by means of the benzol test, and a value awarded to each based on personal judgment of its degree of medullation. Account was taken, in an arbitrary manner, of both the coarseness of the medulla present and the percentage of fibre in the staple so affected, and the results were combined into a single value, with a possible maximum of 300. In this way an attempt was made to translate the visual impressions given by the test into numerical values, for in no other way could comparisons of a large number of staples be made and recorded.

The numerical expression of the degree of medullation of a staple from its appearance under the benzol test presents a difficult and complicated problem, which has not yet been satisfactorily solved. A discussion of the difficulties involved and the proposed means of overcoming them will be given in a second article.* The method used for this experiment, while it is not strictly accurate, has served its purpose in enabling the classification of the staples to be made, so that fleece maps could be drawn, showing the distribution of medulla in the fleeces examined (see Fig. 2).

Each black dot marks the position of a tested staple, small groups of dots representing bundles of adjacent staples. The areas covered with single shading are those in which the staples tested possessed more than a slight trace of medullation. The areas covered with double shading are those in which the staples tested received values of 100 or more out of 300; and they cover roughly those parts of the fleeces in which the wool was hairy to the naked eye.

Parts of the unshaded areas were free of even the slightest trace of medulla, especially on the neck area (as defined in Fig. 1), *the last stronghold of pure wool;* while the remaining parts possessed various slight and relatively insignificant amounts of medullation unevenly distributed. Fig. 3 illustrates this by showing the actual value assigned to each staple of one of the fleeces.

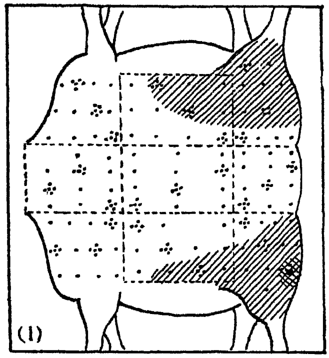
A study of these seven fleece maps, arranged in order of increasing degrees of medullation, shows that medullation is distributed over them according to a simple rule which may be stated as follows: With increasing degrees of medullation the area affected spreads from the britch only, the flank being invaded before the rump, the rib before the back, and the shoulder before the wither, the last-named area being the least likely of all to be medullated. Furthermore, no striking differences between the two sides of an animal are indicated.

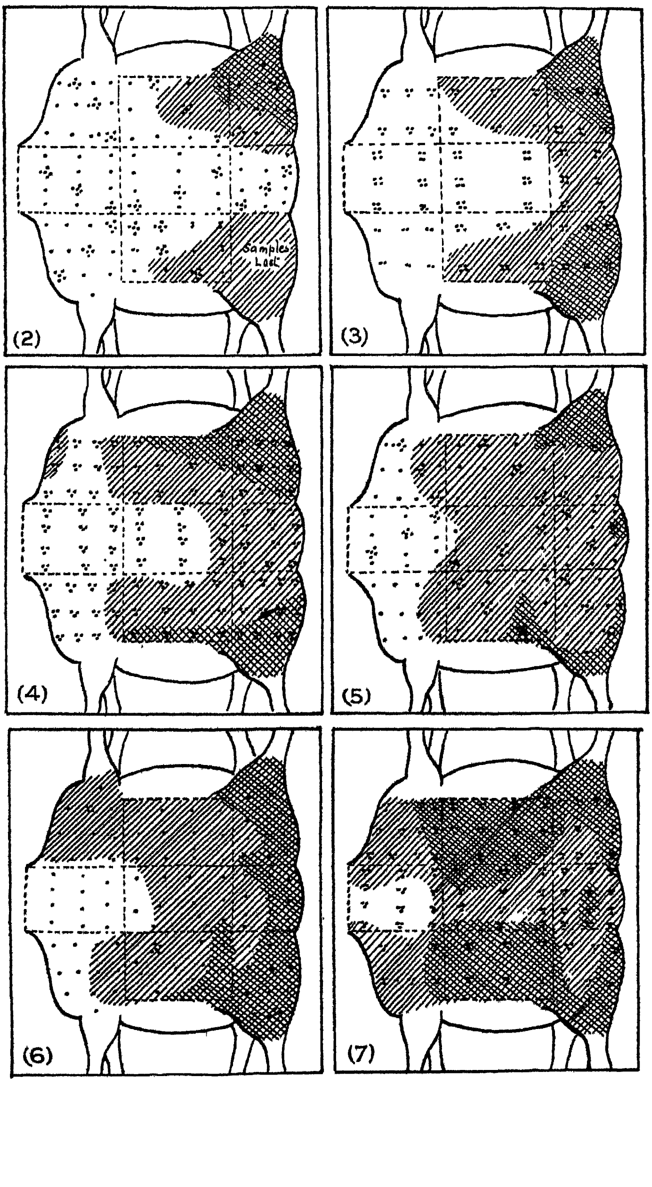
This rule may not apply to aged sheep, about which no definite information has yet been obtained.

* It is proposed to publish this in next month's (April) issue of the *Journal*.—Ed.

FIG. 2. FLEECE MAPS OF SEVEN ROMNEY EWE FLEECES, SHOWING MODE OF DISTRIBUTION OF MEDULLATION.

(Details explained on opposite page.)





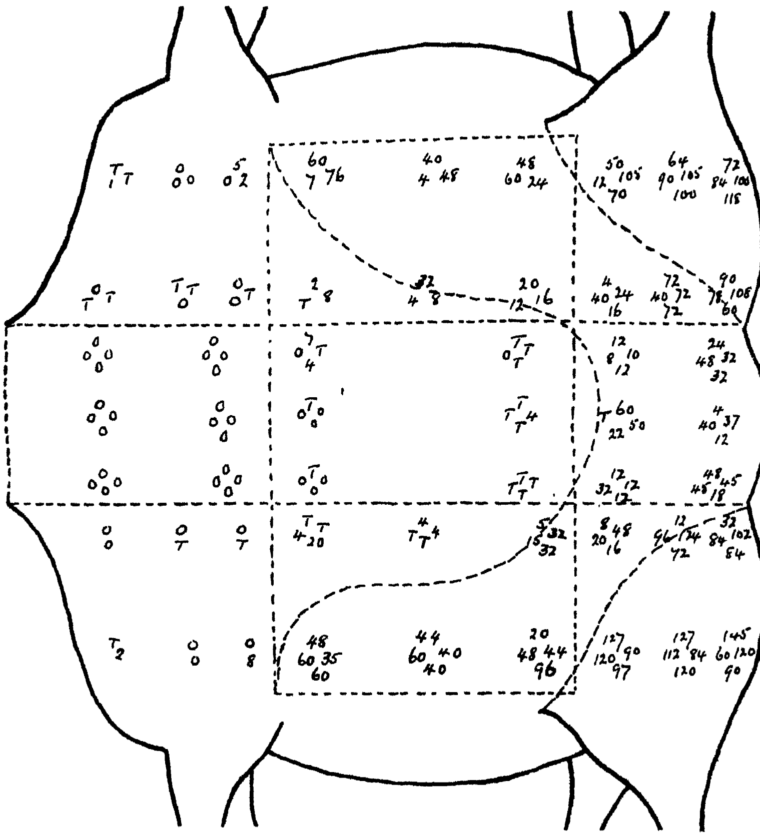


FIG. 3. SHOWING TESTS OF 192 STAPLES FROM A ROMNEY TWO-TOOTH EWE FLEECE. Degrees of medullation are awarded to each staple out of a maximum of 300. "T" signifies trace only.

It must be realized that final conclusions cannot be drawn from the examination of seven fleeces, and that these results require confirmation by a similar examination of a larger number of fleeces from several different Romney flocks. However, the fact that these fleeces were selected at random, and that they fall into so simple and orderly a progression, suggests that the results are significant and useful pending the accumulation of further experimental data.

Fleece-sampling.

The conclusions that may be drawn tentatively from the above results are that fleece-sampling may be confined to the britch, side, and shoulder wools on one side of the animal, and that over those areas one may confidently expect the wool to improve regularly in its freedom from medullation as one advances toward the shoulder.

The actual method of sampling to be employed must depend on whether or not the staples are being tested on the spot. In the case of a breeder testing his own flock, the testing of the staples will usually be carried out in the yards or wool-shed at the time of sampling, and accordingly the extent to which any particular fleece is sampled will depend on the individual circumstances. Thus in some cases the first few staples to be tested may either condemn the animal straight away or raise it above suspicion, so that further testing would be unnecessary. In other cases further examination would be required.

And here each breeder who is endeavouring to eradicate hairy fibre will have to make his own decision as to the extent to which he can afford to eliminate medullation from his flock, or, in other words, as to the point at which he must for the time being be content to draw the line in his discrimination against medullation. For it is certain that the introduction of the benzol test is revealing that medullation is far more common a feature than was supposed, and there are probably few Romney flocks to-day from which it would be economically possible to cull out straight away all fleeces containing *some* medullation.

In view of this fact, and also with due regard to the controversy over the question of whether or not it is desirable to eliminate medullation from the britch wool, it may be advisable, for the time being, to direct attention mainly toward improving the uniformity and freedom from medullation of the main body of the fleece, apart from the britch. This is a matter which cannot be settled by a few short experiments, and on which time alone can pronounce a verdict.

However, on this basis the flank becomes the critical point for examination, since this is the first point to which medullation is shown to spread from the confines of the britch. Hence, the first samples should be taken from this area. If the flank is found to be free of medullation, then the whole of the rest of the fleece, with the exception of the britch, is presumably also free, while the britch may or may not be free. If the flank is not free it should then be the aim to find out how far along the side of the animal the medullation has spread. Thus, next the rib and finally the shoulder wool should be tested.

As emphasized already, one staple cannot give a reliable picture of any one of these areas, and in the writer's opinion, based on the examination of a large number of fleeces, never less than four evenly distributed staples should be taken and tested from any one area. In some cases these may be all the same; but in other cases they will be all different, and quite erroneous conclusions would then be drawn by testing one staple only.

As continuous attention to the elimination of medullated fleeces steadily improves the average standard of the flock in this respect, so it will become possible, if desired, to impose a stricter standard in the process of selection, while at the same time the care and detail required in fleece-sampling would become correspondingly greater.

When the testing of the staples is not being carried out on the spot, then the process of sampling must be cast into a uniform standard procedure capable of dealing satisfactorily with any fleece likely to be encountered. In this case all three areas—britch, side, and shoulder—

must be sampled regardless of their nature, and a sufficient number of staples must be taken from each area to be certain of obtaining a representative sample of that area. Further information on this aspect of the subject will be given when dealing with large-scale flock-testing in the forthcoming second article.

It must be remembered that the conclusions presented above with regard to fleece-sampling depend so far on the study of only a very few fleeces, and therefore they cannot at present be regarded as anything but tentative. They are published now because they do represent a decided advance in our knowledge of the Romney fleece, and because, though provisional, they may serve as a helpful guide to breeders in their own flock-testing. However, the possibility of exceptions to the rules now given must not be overlooked.

An extension of this work to a larger number of fleeces from different flocks is now in hand, and all the evidence so far available is in support of the conclusions presented in this article. The same animals will also be examined year after year, so that accurate information may be obtained on the relative amounts of medullation occurring in the successive fleeces of the same sheep. Results on this work will be published from time to time as they become available.

Summary.

The importance of selecting against the presence of medullated fibres in the New Zealand Romney fleece is being appreciated, and a large number of stud-breeders are now using the benzol test in selecting their breeding-stock.

The question of selecting fleece-samples has been complicated by the facts (1) that adjacent staples in the fleece often differ greatly in their degrees of medullation, and (2) that no precise information has been available as to the mode of distribution of medullation over the Romney fleece.

The fleeces of seven Romney hogget and two-tooth ewes, selected at random, were sampled in great detail (up to 324 staples per fleece), the staples tested by the benzol test, and fleece maps drawn showing the distribution of medullation. The results consistently suggest the following rule :—

With increasing degrees of medullation, the area affected spreads from the britch only, the flank being invaded before the rump, the rib before the back, and the shoulder before the wither, the last-named area being the least likely of all to be medullated. No striking differences between the two sides of an animal are indicated.

It is concluded provisionally that the britch, side, and shoulder wool on one side of the sheep give a true indication of the nature of the whole fleece, while not less than four evenly-spaced staples should be taken as a sample from any one of these areas.

Accepting the present doubt as to the advisability of eliminating medullation from the britch, and concentrating on the improvement of the rest of the fleece, the flank becomes the critical point for examination.

References.

(1) "Medulla in Wool." B. L. Elphick. *N.Z. Jour. of Agri.*, Feb., 1931.

(2) "A Simple Wool-testing Outfit." B. L. Elphick. *N.Z. Jour. of Agri.*, May, 1931.

TURNIP-MANURING EXPERIMENTS IN THE SOUTH ISLAND.

SUMMARY OF RESULTS FOR SEVEN SEASONS, 1924–25 TO 1930–31.

Fields Division, Department of Agriculture.

DURING the past seven years fifty-eight turnip or swede manuring experiments have been conducted in the South Island by the Fields Division, and the salient features of these are here presented.

A description of the work and a discussion of the results obtained was published in the *Journal* for October, 1928[1]*. The chief findings up to the end of the 1927–28 season were as follows :—

(1) Superphosphate at 1 cwt. per acre gave decidedly better yields than Ephos or Nauru phosphates.

(2) A mixture of super and Ephos in equal parts at 1 cwt. per acre was practically as effective as 1 cwt. of super.

(3) Germination injury caused by super increased as the quantity in contact with the seed increased.

(4) Predrilling of most of the super, followed by sowing a small amount with the seed across the direction of the predrilling, had given promising results.

(5) Sowing seed and manure in 7 in. rows, instead of adopting the more common practice of sowing in 14 in. rows, gave promise of good results, especially if the rate of seeding was increased.

(6) Mixing super with an equal quantity of carbonate of lime reduced injury to germination, and had caused a substantial increase in yield in one experiment. Farmers' experience indicated that this was good practice also.

A number of the above findings have been put to further test since 1927–28. Recommendations to farmers based on the results of the first six years' experimental work appeared in the *Journal* for November, 1930[2].

In both the above-mentioned articles, [1] and [2], the injury to germination caused by super and the subsequent reduction in yield were discussed. It was mainly with the object of eliminating this germination injury and at the same time increasing yield that the experiments under review were planned. The objects of the experiments in brief were as follows :—

(1) To determine the extent of the germination injury caused by using 1 cwt. or 2 cwt. of super respectively, and to investigate the possibility of overcoming this injury and increasing yield by mixing the super with carbonate of lime or rock phosphate (Ephos was the rock phosphate used in nearly all trials). At the Gore Experimental Area, where sowing on ridges is the practice, super was used at the rate of 3 cwt. per acre, varying quantities with and below the seed being used.

* Small figures in brackets indicate references at end of article.

(2) To determine the effect on germination and yield of mixing super and carbonate of lime for different times before sowing.

(3) To compare the effect of commercial basic super with the mixture of super plus carbonate of lime, and super plus slaked lime, on germination and yield.

(4) To compare 14-in.-row sowing with 7-in.-row sowing.

(5) To investigate methods of sowing super with the seed so that contact of seed with manure is minimized.

(6) To test the effect of nitrogenous and potassic fertilizers with the seed, postdrilled and predrilled.

All plots in the experiments were replicated so that yield could be examined statistically by "Student's" method. The method of conducting experiments when sowing on the flat was described in the *Journal* for July, 1926(3).

The method of determining field germination was described in the *Journal* for July, 1926(3), and October, 1928(1). The extent of the germination injury caused by superphosphate is indicated by the following: The average of thirty-one trials conducted up to the present time in which plots receiving 1 cwt. super per acre (seed and manure in 14 in. rows) could be compared with plots receiving no manure, ground rock phosphate, or super plus carbonate of lime (equal parts) shows that the super reduced the germination to 65·5 per cent. of that occurring with other treatment mentioned. Super at 2 cwt. per acre had a still greater effect on germination when sown with the seed in 14 in. rows. A comparison of super 2 cwt. with plots sown with super 2 cwt. plus lime 2 cwt. in fourteen experiments shows that the germination of super 2 cwt. was 43·2 per cent. of that in the super plus lime plots. Almost total killing was caused in one experiment.

1. Results obtained from Super at 1 and 2 cwt. per Acre, Mixture of Super and Carbonate of Lime, and Mixture of Super and Ephos.

All the experiments discussed under this heading, except two, were conducted in Canterbury. Two were carried out in North Otago in 1930–31.

(1) SUPER 1 CWT. COMPARED WITH MIXTURE OF SUPER 1 CWT. PLUS CARBONATE OF LIME 1 CWT. PER ACRE.

In nearly all cases the mixing of the super and lime was done from one week to several weeks before sowing.

(*a*) *Seed and Manure in 14 in. Rows.*—Super 1 cwt. has been compared directly with super 1 cwt. plus carbonate of lime 1 cwt. in twenty-four experiments conducted during 1928–29 to 1930–31 inclusive, with the following results:—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 1 cwt. per acre	9·9	11·7
Super 1 cwt. plus carbonate of lime 1 cwt. per acre	17·1	15·1
Difference	42 per cent.	3·4

The germination on super plots is 42 per cent. less than that on plots sown with super plus lime. The increase in yield due to super plus lime is undoubtedly due to the greater number of plants and their more even distribution resulting from elimination of injury to germination.

(*b*) *Seed and Manure in 7 in. Rows.*—Seven experiments are available for this comparison, the results being:—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 1 cwt.	21·2	15·5
Super 1 cwt. plus carbonate of lime 1 cwt. per acre	26·6	16·2
Difference	20 per cent.	0·7

The reduction in germination caused by super in this case is 20 per cent. The difference in yield is slight. Since twice as many 7 in. rows are sown as when 14 in. rows are used, and the rate of sowing of manure per acre is the same, it must be remembered that only half as much manure is in contact with the seed when 7 in. rows are used.

NOTE.—In this and all other comparisons, except in Section 4, the germination and yields of 14-in.-row sowings cannot be compared with germination and yields of 7-in.-row sowings, as different experiments are represented in the averages of the two. Most of the experiments in which the turnips were sown in 7 in. rows were located in South Canterbury where, in addition to the sowing through every coulter of the drill being common practice, the rate of seeding is usually higher than in other parts of Canterbury. Hence the number of plants per area of 10 ft. by 14 in. is, throughout this report, usually higher in the case of sowings in 7 in. rows than in 14 in rows. Although germinations and yields of the 14-in.-row sowings cannot be compared with germinations and yields of the 7-in.-row sowings, the *differences* shown, in relation to the actual germinations and yields indicate the relative effect of the treatments.

(2) SUPER 1 CWT. COMPARED WITH SUPER 2 CWT. PER ACRE.

(*a*) *Seed and Manure in 14 in. Rows.* — Eleven experiments are available in which super 1 cwt. has been compared directly with super at 2 cwt. per acre. The results are as follow:—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 1 cwt.	9·8	11·1
Super 2 cwt.	6·6	11·1
Difference	30 per cent.	..

Plots receiving super 2 cwt. have germinated 33 per cent. less than those receiving 1 cwt. per acre. The average yields are identical. Compare this with (3*a*) below, where super 2 cwt. plus carbonate of lime 2 cwt. per acre have given a substantial increase in yield over super 2 cwt. Apparently the number of plants on super 2 cwt. plots is too few to take full advantage of the manure applied, but when germination injury is eliminated and the number of plants increased, better utilization of the manure is reflected in an increase in yield. This applies also to (2*b*) below, where germination injury is reduced by having less super in contact with the seed.

(*b*) *Seed and Manure in 7 in. Rows.*—Six experiments give the following averages :—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 1 cwt.	26·6	18·5
Super 2 cwt.	22·8	19·8
Difference	14 per cent.	1·3

By doubling the number of rows and halving the manure per row, super at 2 cwt. per acre gives a germination of 14 per cent. less than that of super 1 cwt. in six experiments. Although the number of plants is reduced by the greater quantity of super, there are still enough plants to take advantage of the extra manure, and an increase in yield of 1·3 tons per acre has resulted from the heavier dressing.

(3) SUPER 2 CWT. COMPARED WITH SUPER 2 CWT. PLUS CARBONATE OF LIME 2 CWT. PER ACRE.

(*a*) *Seed and Manure in 14 in. Rows.*—Thirteen experiments lend themselves to comparing the above treatments. The average results are :—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 2 cwt.	7·6	9·5
Super 2 cwt. plus carbonate of lime 2 cwt. ..	15·7	14·1
Difference	52 per cent.	4·6

In the above experiments the average germination of super 2 cwt. plots is about 52 per cent. less than that of super plus lime. The greater number of plants in the latter have yielded 4·6 tons per acre more than the smaller number of plants on the super 2 cwt. plots.

(*b*) *Seed and Manure in 7 in. Rows.*—Six experiments are averaged in this case, the results being :—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 2 cwt.	20·6	19·1
Super 2 cwt. plus carbonate of lime 2 cwt. ..	29·0	21·6
Difference	29 per cent.	2·5

Halving the amount per row by doubling the number of rows shows much less injury due to super, which has germinated 29 per cent. less than super plus lime. The result on yield is in favour of super plus lime to the extent of 2·5 tons per acre. Although the plants on the super 2 cwt. plot would appear to be thick enough (practically two plants per square foot) the greater number of plants on super plus lime has again proved superior. It is probable that this superiority is not so much due to the greater number of plants in this case as to the fact that the individual plants do better. In addition to germination injury heavy dressings of super in contact with the seed retard the development of the young plants quite markedly in their early growth. It would appear that this is due to a too concentrated soil-solution tending towards plasmolysis of the plants. Presumably the lime reduces the solubility of the super to some extend at least, although its efficacy is obviously not impaired.

(4) SUPER 1 CWT. PLUS CARBONATE OF LIME 1 CWT. COMPARED WITH SUPER 2 CWT. PLUS CARBONATE OF LIME 2 CWT. PER ACRE.

(a) Seed and Manure in 14 in. Rows.—Seventeen experiments are available for comparing the above manures, with the following results :—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 1 cwt. plus carbonate of lime 1 cwt ..	16·4	15·3
Super 2 cwt. plus carbonate of lime 2 cwt. ..	16·1	17·0
Difference		1·7

There is no appreciable difference in the germination following the two treatments. The average increase of 1·7 tons per acre is made up of increases ranging from 0·3 tons to 4·6 tons per acre, with one exception where there was no difference. Broadly speaking, the bigger increases from the heavier dressing were obtained on the better-class turnip land as represented by that in the vicinity of Waddington and Sheffield. These results should be compared with those under (2*a*), where super 2 cwt. is no better than super 1 cwt. The heavier dressing of super is of no advantage on the average when sown in 14 in. rows unless accompanied by the use of lime to overcome the undesirable effects on germination and growth of young plants.

(b) Seed and Manure in 7 in. Rows.—The average results for ten experiments are as follow :—

	Average Field Germination: Plants per Area 10 ft by 14 in	Average Yield in Tons per Acre.
Super 1 cwt. plus carbonate of lime 1 cwt. ..	24·2	17·8
Super 2 cwt. plus carbonate of lime 2 cwt ..	24·4	19·5
Difference		1·7

The two treatments have given virtually the same germination, and the average increase from the heavier manuring is the same as in (4*a*) above—namely, 1·7 tons per acre. In one experiment the super 2 cwt. and lime 2 cwt. was 0·2 ton lower in yield than super 1 cwt. and lime 1 cwt., but in the others the increases ranged from 0·5 to 4·8 tons per acre. No really light land is represented in this series, and there does not appear to be any consistent superiority from the heavier dressings on the better-class land over its effect on the medium-class soils.

(5) SUPER 2 CWT. COMPARED WITH SUPER 1 CWT. PLUS EPHOS 1 CWT. PER ACRE.

(a) Seed and Manure in 14 in. Rows.—The results of ten experiments are averaged with the following results :—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 2 cwt.	6·1	10·3
Super 1 cwt. plus Ephos 1 cwt.	11·3	13·5
Difference	46 per cent.	3·2

Super at 2 cwt. has given an average germination about 46 per cent. less than that from the mixed phosphates. The yield is 3·2 tons per acre in favour of the latter.

(*b*) *Seed and Manure in 7 in. Rows.*—Only three experiments are available for comparison in this case.

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 2 cwt.	25·9	23·2
Super 1 cwt. plus Ephos 1 cwt.	28·8	21·6
Difference	10 per cent.	1·6

The germination on the super plots is 10 per cent. less than that on the super plus Ephos ones. The average yield is in favour of the super in this case, where the concentration of the super is only half that of (5*a*) above.

(6) SUPER 2 CWT. PLUS CARBONATE OF LIME 2 CWT. COMPARED WITH SUPER 1 CWT. PLUS EPHOS 1 CWT. PER ACRE.

(*a*) *Seed and Manure in 14 in. Rows.*—Ten experiments are averaged with the following results:—

	Average Field Germination: Plants per Area 10 ft by 14 in.	Average Yield in Tons per Acre.
Super 2 cwt. plus carbonate of lime 2 cwt. ..	16·2	15·8
Super 1 cwt. plus Ephos 1 cwt.	11·3	13·5
Difference	30 per cent.	2·3

The super plus Ephos mixture has germinated about 30 per cent. less than the super 2 cwt. plus lime 2 cwt. plots. Consideration of this comparison and (7*a*) below indicates that the injury to germination is more or less proportionate to the amount of super in the mixture of the super and Ephos. Mixing super with a rock phosphate such as Ephos does not lessen the injurious effect of the super itself on germination to an appreciable extent.

(*b*) *Seed and Manure in 7 in. Rows.*—The averages for three experiments are as follow:—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 2 cwt. plus carbonate of lime 2 cwt. ..	30·5	22·8
Super 1 cwt. plus Ephos 1 cwt.	28·4	21·6
Difference	7 per cent.	1·2

The average germination in the super and Ephos treatment is about 7 per cent. less than that in the super plus lime. Halving the manure per row and doubling the number of rows again reflects the reduction in germination injury from the super in the mixed phosphates as a result of having a lesser amount in contact with the seed. There is an advantage in yield from the super plus lime mixture.

(7) SUPER 2 CWT. PLUS CARBONATE OF LIME 2 CWT. COMPARED WITH SUPER 1 CWT. PLUS EPHOS 1 CWT. PLUS CARBONATE OF LIME 1 CWT. PER ACRE.

(*a*) *Seed and Manure in 14 in. Rows.*—The results of ten experiments in which the above treatments were used give the following averages:—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 2 cwt. plus carbonate of lime 2 cwt. ..	16·2	15·8
Super 1 cwt. plus Ephos 1 cwt. plus carbonate of lime 1 cwt.	15·6	14·7
Difference		1·1

The addition of lime to the super plus Ephos mixture has resulted in average germination very similar to that from super plus lime. This should be compared with (6*a*) above, where super plus Ephos without the addition of lime germinated 30 per cent. less than super plus lime.

(*b*) *Seed and Manure in 7 in. Rows.*—Only three experiments are available for averaging, the results being :—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 2 cwt plus carbonate of lime 2 cwt ..	30·5	22·8
Super 1 cwt. plus Ephos 1 cwt. plus carbonate of lime 1 cwt.	30·7	22·2
Difference		0·6

The differences between the two treatments are very small, and in none of the experiments were they significant. In two cases the results were in favour of super plus lime, and in the other slightly in favour of super plus Ephos plus lime.

(8) SUPER 1 CWT. PLUS EPHOS 1 CWT. COMPARED WITH SUPER 1 CWT. PLUS EPHOS 1 CWT. PLUS CARBONATE OF LIME 1 CWT. PER ACRE.

(*a*) *Seed and Manure in 14 in. Rows.*—Ten experiments are averaged in this case.

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 1 cwt. plus Ephos 1 cwt.	11·3	13·5
Super 1 cwt. plus Ephos 1 cwt. plus carbonate of lime 1 cwt.	15·6	14·7
Difference	28 per cent.	1·2

The super plus Ephos has given 28 per cent. lower germination than when lime is added. The yields are in favour of the mixture containing lime.

(*b*) *Seed and Manure in 7 in. Rows.*—Three experiments are averaged giving :—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 1 cwt. plus Ephos 1 cwt.	28·8	21·6
Super 1 cwt. plus Ephos 1 cwt. plus carbonate of lime 1 cwt.	30·7	22·2
Difference	6 per cent.	0·6

The differences in germination and yield are comparatively small. Only one experiment—super plus Ephos plus lime—was significantly better in yield than super plus Ephos.

2. Time of mixing Super and Lime prior to Sowing.

Table 1 shows the average field germination and yield in four experiments carried out to investigate the effect of varying the proportions of super to lime, and the time between mixing the super and carbonate of lime and sowing the crop. Super 2 cwt. without lime is included as a comparison with the other treatments. Three experiments were sown in 14 in. rows and one in 7 in. rows.

Table 1.

Treatment per Acre.	Time of Mixing.	Average Field Germination: Number of Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 2 cwt.	..	11·3	9·1
Super 2 cwt. plus lime 1 cwt.	Immediately before sowing	16·3	11·8
Super 2 cwt. plus lime 2 cwt.		19·4	13·0
Super 2 cwt. plus lime 1 cwt.	One day before sowing	17·2	11·5
Super 2 cwt. plus lime 2 cwt.		19·1	13·3
Super 2 cwt. plus lime 1 cwt.	One week before sowing	18·5	12·0
Super 2 cwt. plus lime 2 cwt.		21·4	13·4

The germination and yields are considerably better on all plots receiving the mixture of lime and super than on those receiving super alone. Using two parts of super to one part of lime has not reduced germination injury nor increased yield to the same extent as the mixture containing equal parts of super and lime.

Varying the time between mixing the super and lime and sowing has caused comparatively little difference in germination and yield. The practice which some farmers adopt of mixing in the field immediately before sowing would appear to give quite good results, only a little inferior to those from a mixture made a week before sowing. Mixing at least a week before sowing is recommended if facilities are available for doing this. Time will be saved during sowing, although it must be understood that mixed material should not be bagged until it has been left in a heap for a day or two, after which it should be turned with a shovel. The mixture will set slightly, but is easily broken up, after which it will not set again.

(To be concluded.)

Summer Control of Red-mite in Orchards.—In the 1930 season summer spraying with various oils was carried out with good results for the control of red-mite, in some plots 95 per cent. control of the pest being secured. Some of these trees form part of a black-spot spraying experiment this season, in conjunction with others that did not receive the summer oil treatment. The difference in appearance of the trees which received the summer oil treatment and the others is remarkable. The former have remained practically free from red-mite infection, while the latter show a very perceptible infection, though all have received the same treatment this year. It would appear from these experiments that it is more beneficial to successfully control red-mite during the growing season than allow the pest to accumulate during the late summer and carry over a heavy infestation of eggs, and endeavour to destroy them by heavy applications of oil in winter or spring.—*J. H. Thorp, Orchard Instructor, Nelson.*

BOYS' AND GIRLS' AGRICULTURAL CLUBS.

RECORD OF ACTIVITIES IN 1930–31 SEASON.

Fields Division, Department of Agriculture.

BOYS' and girls' agricultural club activities throughout the Dominion for the season 1930–31 were characterized generally by success and expansion. In all districts in which clubs existed previously there was an increase in the total entries finally judged. In two districts—Hawke's Bay and Canterbury—clubs were inaugurated on a fairly extensive scale and with considerable success, even though the amount of attention given the new clubs was somewhat restricted on account of the limited funds available.

(1) Wellington, Taranaki, and Hawke's Bay Area.

Though agricultural clubs have been operating in the Wellington-Taranaki area for many years, the movement is not at all stabilized and important changes are taking place. In Taranaki, for instance, there has been a substantial decline in the crop competitions. Of the factors operating to bring about this result the main are probably (1) the increased claims to attention of the calf clubs, (2) the falling in relative importance of special crops in Taranaki farming, because of the greater attention given to ensilage, and (3) the weakening of interest that naturally is likely to occur in a movement which has lost all traces of novelty because of its long-continued existence.

The crop competition entries also declined to a fairly substantial extent in the Wanganui - Main Trunk districts, and to a slight extent in the Wairarapa. On the other hand, there was an increase in the Manawatu, while crop competitions were conducted for the first season in Southern Hawke's Bay, where on account of restricted funds a limit was set at the beginning to the number of entries that would be accepted. The additional entries in Manawatu and Hawke's Bay were not sufficient to offset completely the decline in other districts, so that the total completed entries for the whole area numbered 657, compared with 742 in 1929 and 847 in 1928.

The advance in popularity of the calf clubs much more than counterbalances the decline in crop competition activities. The good support previously given the calf clubs in Taranaki was maintained, and, in addition, calf clubs were introduced in the Manawatu, Southern Hawke's Bay, Horowhenua, and Wairarapa districts. In Horowhenua, because of restricted funds, the calf club organization received no financial assistance from official sources. Nevertheless its activities were characterized by efficiency and success.

Generally, the calf-club movement has quickly won popular support and appreciation, and the co-operation readily accorded by prominent breeders and progressive farmers generally augurs well for the continued success and expansion of the movement. The number of calves judged

in the Wellington-Taranaki area according to districts during the past two seasons is as follows:—

	1929–30.	1930–31.
North Taranaki	291	251
South Taranaki	360	403
Manawatu	..	187
Hawke's Bay	..	65
Wairarapa	..	43
Horowhenua	..	55
	651	1,054

The completed entries in the crop competitions in the same area were:—

	1929–30.	1930–31.
North Taranaki	131	66
South Taranaki	118	101
Wanganui - Main Trunk	221	177
Manawatu	179	211
Wairarapa	76	69
Southern Hawke's Bay	..	33
Ohura	17	..
	742	657

Crop Competitions.

In North Taranaki the crop competitions were carried on as previously with mangels and swedes, variety trials which were incorporated in the competitive work adding materially to the interest aroused. The varieties of mangels grown were Prizewinner Yellow Globe, which averaged 55·4 tons per acre, and White Sugar, which averaged 49·9 tons—a result which confirms previous experience indicating that, in yield, Prizewinner Yellow Globe excels in North Taranaki trials. The mangel championship was won by Douglas Strong, Tataraimaka School, with a crop of 128·5 tons per acre.

The swede varieties grown were Vilmorin's White-fleshed Purple-top, which averaged 35·9 tons per acre; Superlative, 31·4 tons; and Herning, 29·9 tons. The swede championship was won by Connie Stapleton, of Egmont Village, with a crop of 49·6 tons per acre.

In South Taranaki carrots and mangels were grown. The mangel yield averaged 52·45 tons per acre, a decrease of over 6 tons per acre in comparison with the previous season, this being due partly to unfavourable weather conditions. The variety yields were: Prizewinner Yellow Globe, 58·8 tons; White Sugar, 46·1 tons. The champion crop was that of Will. Laursen, with 98·45 tons per acre.

In carrots the average yield was 45·15 tons, an increase of nearly 10 tons per acre over the previous season. The variety yields were: Matchless White, 43·95 tons; Guerande, 46·35 tons per acre. The champion crop was that of John Cook, Huinga, with 75·85 tons per acre.

In the Manawatu-Oroua district mangels and maize were grown. The mangel crop, Prizewinner Yellow Globe, averaged 45·2 tons per acre, a decrease of over 5 tons per acre in comparison with the previous season, due primarily to the unfavourable conditions. The champion crop was that of E. Thompson, Kopane, with 122·3 tons per acre.

The maize class was included in the competition for the express purpose of trying out quick-maturing varieties recently introduced to

the district from America in the hope that they would prove suitable for grain-production for pig-feeding. The crops were disappointing, being damaged by early frosts. The average yield was 23·4 bushels per acre. The champion crop was that of D. Christensen, Oroua Downs, with 45 bushels per acre.

In the Wairarapa Prizewinner Yellow Globe mangels were grown. The average yield was 48·1 tons per acre, this being 10 tons per acre greater than that of the previous year. The champion crop was that of Quentin McGovern, Mauriceville, with 98·5 tons.

In Southern Hawke's Bay, holding crop competitions for the first season, Prizewinner Yellow Globe was grown and averaged 40·5 tons per acre. The champion crop was that of Winifred Skinner, Woodville, with 79·35 tons per acre.

Calf Competitions.

In both North and South Taranaki calf competitions are not only well established but continue to grow in popularity. The competitions were in general carried out along the lines of previous years. The competition caters for both pedigree and grade animals in separate classes, and distinct competitions for (*a*) dairy type and (*b*) condition are scheduled. As previously, the interest and assistance of supervisors, parents, and teachers have been a feature of the competitions and have contributed materially to their continued success.

Championship winners are given in the following table:—

Class.	Competition.	Winner.
	North Taranaki.	
Jersey-Ayrshire ..	Condition ..	T. Stockman (champion), Oaonui School
,, ..	Type ..	Bill Mullan (champion), Bell Block School.
Shorthorn-Friesian ..	Condition ..	J. Tebbutt (champion), Egmont Village School.
,, ..	Type ..	Jean Tebbutt (champion), Egmont Village School.
Pedigree Jersey ..	Condition ..	Rupert Loveridge (champion), Tariki School.
,, ..	Type ..	N. Sampson (champion), Hillsborough School.
Pedigree Ayrshire ..	Condition ..	Richard Philp (champion), Fitzroy School.
,, ..	Type ..	Lindsay Weir (champion), Lower Mangorei School.
Pedigree Friesian ..	Condition ..	Venice Peters (champion), Kaimiro School.
,, ..	Type ..	Venice Peters (champion), Kaimiro School.
	South Taranaki.	
Jersey-Ayrshire ..	Condition ..	Vera Stallard, Bird Road.
,, ..	Type ..	Myra Wren, Tokoura.
Shorthorn-Friesian ..	Condition ..	Ivy Major, Toko. S. Stallard, Bird Road (equal).
,, ..	Type ..	L. Stallard, Bird Road.

In the remaining districts of the Wellington area calf clubs, being in their first season, were not so specialized in class as in Taranaki,

the competition being open only to grade calves for which the following classes generally were scheduled: (*a*) Dairy type, (*b*) evidence of good rearing. In general the calf-club work met with success and evoked a remarkable amount of interest, and this, together with most valuable assistance forthcoming from prominent breeders and officers of show associations, as well as from parents and teachers, augurs well for the continued success of the clubs. The principal results were as follows :—

Manawatu Championship.—Dairy type—C. Webb, Glen Oroua. Rearing—J. Clark, Kairanga.

Southern Hawke's Bay Championship.—Dairy type—C. Phillips, Te Rehunga. Rearing—C. Phillips, Te Rehunga.

Wairarapa.—(*a*) Pahiatua: Dairy type—E. Bryant, Ruawhata. Rearing—E. Bryant, Ruawhata.

(*b*) Carterton: Dairy type—R. Hawke, Clareville. Rearing—J. Edwards, Ponatahi.

The Henry Low and Co. challenge shield for the school doing the best club work was awarded to Egmont Village, as was also the Trimble Shield.

(2) Canterbury Area.

The clubs were first started in Canterbury in 1930. The number of plots inspected was as follows: Mangels, 120; potatoes, 646: total, 766. Of these, 700 reached the final judging stage.

In spite of the dry season yields were quite high, the average being—Potatoes, 10 tons an acre; mangels, 33 tons. The highest yields were—Potatoes, 27·5 tons an acre; mangels, 85 tons.

The work seems to have suffered because it was not characterized by the local interest and supervision which is so prominent in districts in which agricultural clubs are particularly successful.

(3) Otago and Southland Area.

Both crop and calf competitions were conducted with success on an extensive scale in Otago and Southland.

OTAGO.

Crop Competitions.—Though particular districts had conducted crop competitions in previous years in Otago, the season under review marks the first year's operation of the Boys' and Girls' Agricultural Clubs' Association, the executive of which advises that it has every reason to be satisfied with the work done. The crops grown were mangels and carrots.

In carrots there were eighty-four competitors from thirty-three schools. The average yield was 15·95 tons per acre, and the highest yield was 44·6 tons, secured by G. Prentice, Port Molyneux. The championships were won by J. Wilkinson, Teaneraki (Intermediate Division), and T. Landreth, Katea (Junior Division).

The following special awards were made :—

Most points in field-work: Intermediate—R. Newlands, Kauru Hill; Junior—T. Landreth, Katea.

Most points in record-keeping: Intermediate—J. Wilkinson, Teaneraki; Junior—T. Landreth, Katea.

In mangels thirty-eight entries came from twenty-one schools. The average yield was 34 tons per acre, and the highest yield 62 tons per acre secured by Mary Simpson, Maungatua. The mangel championships were won by James Rowlands, Teaneraki (Intermediate Division), and Ivan Smith, Palmerston South (Junior Division).

The following special awards were made :—

Most points in field work: Intermediate—O. Scahill, Windsor; Junior—I. Smith, Palmerston South.

Most points in record-keeping: Intermediate—Hector McDonald, Lovell's Flat; Junior—N. Lory, Awamoko.

The winner of Sutton's silver challenge cup, awarded for the highest aggregate points in crop-growing, was T. Landreth, Katea.

Calf Competitions.—The first year's results with calf competitions in Otago are extremely satisfactory, seventy-five entries having been judged. Awards are based on the condition and type of the calf, considered in conjunction with the records kept by the competitor. The championships awarded in 1930 were :—

Large breeds (Friesian and Shorthorn): Brian Neale, Papakaio, with a Friesian.

Small breeds (Ayrshire and Jersey): I. Ashworth, Galloway, with an Ayrshire.

SOUTHLAND.

Crop Competitions.—Successful competitions, involving a total of 227 completed entries, were conducted in connection with potato, chou moellier, mangel, and carrot crops. The crop championships were won as follows :—

Potatoes (variety King Edward): Greer Miller, Gore.

Chou moellier (variety Green Stem): Alex. Gerrard, Winton (Intermediate Division).

Mangels (variety Prizewinner Yellow Globe): Bert. Hassid, Otautau (Junior Division).

Carrots (variety Red Intermediate): Eric Middleton, Lora Gorge (Junior Division).

The following special awards were made :—

Potatoes: Most points in field-work—Dorothy Patterson, East Chatton School; Annie Middleton, Lora Gorge; Alex. Henderson, Kennington; Alex. Weir, Gore. Best record chart—Greer Miller, Gore.

Chou moellier: Raymond Evans, Longbush.

Mangels: Bert Hassid, Otautau.

Carrots: Barbara Ness, East Chatton.

The following table summarizes the cropping results :—

Crop.	Average Yield per Acre.			Highest Yield per Acre.		
	Tons	cwts.	qrs.	Tons	cwts.	qrs.
Potatoes	15	4	2	27	0	3
Chou moellier	28	11	3	45	9	3
Mangels	23	5	2	50	10	3
Carrots	15	15	0	46	0	0

The crop varieties grown were: King Edward potato, Green Stem chou moellier, Prizewinner Yellow Globe mangel, and Red Intermediate carrot.

The following special trophies were awarded :—

Solid silver shield presented by the Southland council of the New Zealand Institute of Horticulture to the school gaining the highest average aggregate points in cultivation, management, and yield in the crop-growing competition : Lora Gorge School, 61·7 points (six competitors) ; also holder of the shield for the previous season with 59·2 points. Runner-up : East Chatton School, 61·5 points.

Silver shield presented by the Southland Provincial Farmers' Union to the school gaining the highest aggregate points over all phases of work in the crop-growing competition : East Chatton School, 87 points (seven competitors). Previous season's holders, Knapdale School, 85·6 points. Runner-up : Lora Gorge School, 86 points.

Calf Competitions.—The second year of calf clubs in Southland, when 120 entries were judged, was marked by a considerable advance in comparison with the initial year, when thirty-eight entries were received. The clubs are conducted in a similar manner to those of Otago described above. The 1930–31 championships were won by :—

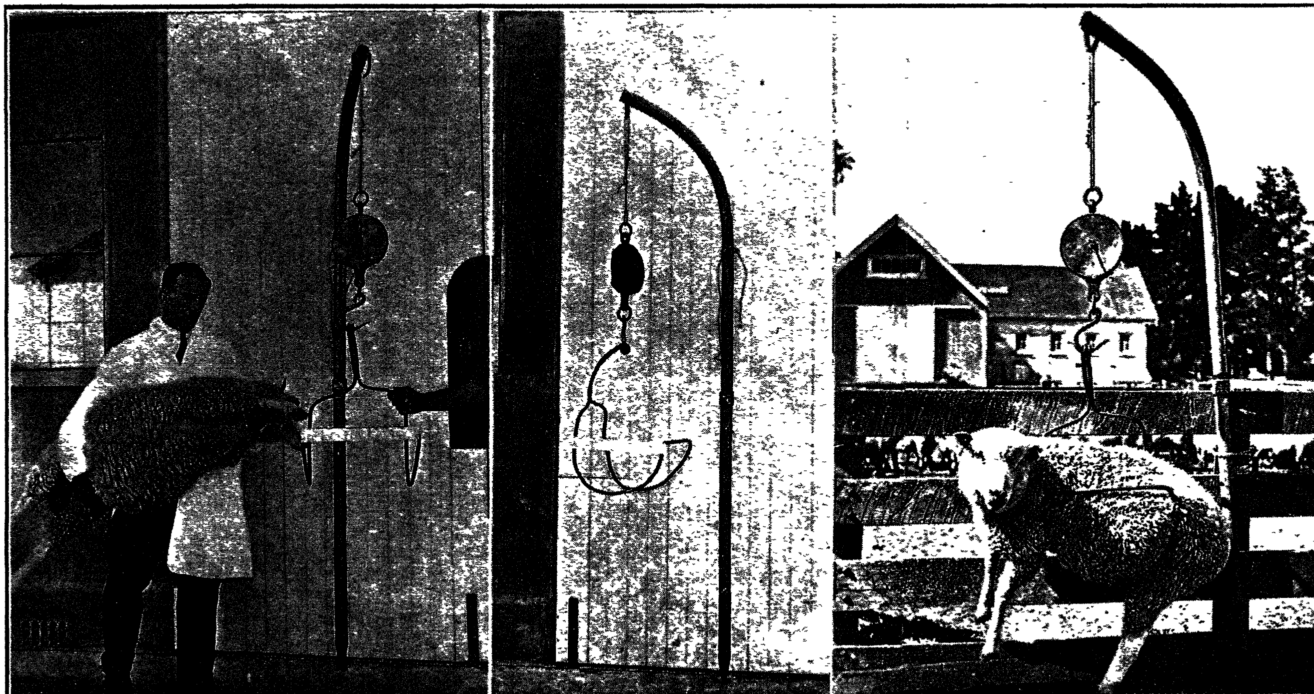
Large breeds : G. Mortimer, Makarewa (Friesian).
Small breeds : L. Hartley, Ryal Bush (Ayrshire).

A SIMPLE APPARATUS FOR WEIGHING SHEEP OR LAMBS.

D. J. Sidey, B.Ag., H.D.D., Canterbury Agricultural College, Lincoln.

The accompanying photographs illustrate a device which has been used at Canterbury Agricultural College for some years for the purpose of weighing experimental sheep, and which has proved both satisfactory and convenient. While a weighbridge may be the most efficient method, it has the disadvantage of high initial cost, and the fact that it cannot be transferred easily from place to place makes its use unsatisfactory for the field experimental worker. The object of these notes is to make this simple and relatively cheap method of weighing sheep widely known to experimental workers, farmers, and fat-lamb buyers.

The apparatus, which can be made in any iron workshop, consists of an upright arm bent at the top to support a spring balance and the sling used for holding the sheep. The most satisfactory arm has proved to be an 8 ft. length of 1½ in. galvanized-iron piping, one end of which is drawn out to a point to penetrate the ground and about a foot length of the top bent over in a gradual curve. A hole is then bored through the pipe at the top end to take a U-shaped shackle (made out of ½-in.-round iron) to which the balance is attached by means of a piece of light rope. In order to facilitate carrying the pipe it has been cut in half and the two halves reconnected by means of a collar, so that they can be unscrewed to fit inside a motor-car. When set up in the sheep-yards the point of the pipe is driven into the ground on the outside of the yard beside a post, and a short piece of rope or wire is used to tie the pipe to the post. If a length of suitable pipe is not



THE WEIGHING APPARATUS AT CANTERBURY AGRICULTURAL COLLEGE.

Left—Front view, showing method of grasping sheep before placing it on sling (the sling is here higher than it would be in practice, owing to the bottom of the pipe being on a raised ridge and not driven into the ground). Centre—Side view of the apparatus (the dark lines on scale in this and the left-hand view represent 3 in. spacings). Right—A sheep in the sling (in actual practice the pipe would be on the other side of the fence).

available a similar device can be made out of 3 in. by 2 in. timber, provided with a cross-arm at the top suitably braced to stand the strain.

A tested spring-balance is used for measuring the weight of the sheep, since it combines ease of reading, stability of the sling, and sufficient accuracy of the weights. While a steel-yard might be used, the fact that some sheep which are unused to the sling may be inclined to struggle, with the result that they may damage the knife-edges and also tip up the sling and thus jump out, makes its general use undesirable.

The sling is made of about 9 ft. of ½-in.-round iron, and the size and shape shown in the photos has proved to be most satisfactory for weighing mixed classes of sheep, but if full-grown animals are to be weighed it might be made a little larger. The bending of the iron is best done at dull red heat although if the iron is sound it could be bent cold, except at the point where the two ends of iron are welded together and bent to form a hole through which to pass the hook of the balance. The sling is about 15 in. long, 14 in. wide, and the curved part is about 10 in. deep.

In the photographs, for the sake of clearness, the sling is shown uncovered, but in actual practice the iron which comes in contact with the sheep is covered with old horse-cover felt to minimize bruising. A sugar-bag is then drawn over the framework to cover all the space between the bars, in order that the legs of the sheep will not slip down between them.

While one man can weigh sheep without a great deal of trouble with this apparatus, he is rather handicapped by having to pick up and put down pencil and note-book. It has been found that three workers give the most efficient results; one man to catch the sheep and place them on the sling; another to read the ear-tag or other numbering device and then to tip the sheep off; and a third to read the weight and record it and the number in a note-book. This gives a continuity to the work, and by exchanging positions to obviate one man doing all the lifting 125 or more sheep should be weighed in an hour.

The most convenient method of placing a sheep in the sling is to stand on the left hand side of the animal, place the left hand under the brisket, grasp the upper portion of the right front leg, and lift the fore end of the sheep off the ground. Then pass the right arm over the back of the sheep, under the stomach and grasp the left hind leg in the region of the stifle. A man of average build should then be able to pick up a sheep weighing up to 120 lb. live-weight, with both pairs of legs stretched out so that the sheep can be placed on the sling with the legs hanging clear. If this latter is not done the sheep are inclined to struggle and to jump off. With sheep over 120 lb. live-weight it may be found advisable to have one man to lift the fore end and another to lift the hind end, thus lightening the work.

The rope used to tie the balance to the shackle in the end of the pipe should be adjusted to such a length that when the sheep is in the sling the legs are just clear of the ground. If the rear end of the sling is raised slightly when the weight and number have been noted the sheep will slide forward, and can run out of the pen if the apparatus has been erected near a gateway.

The writer makes no claim to be the originator of the ideas on which the apparatus is built up; in its present form it represents the work of several people, in particular Mr. M. J. Scott and Mr. D. A. Campbell.

EFFECTS OF THE NOVEMBER FROST IN OTAGO ORCHARDS.

THE abnormal "freeze" which caused considerable damage in orchards in some parts of the Otago District on the morning of 25th November last had some peculiarities not usually associated with the ordinary frost visitation.

During the preceding day the thermometer was down around freezing-point, with frequent rain and hail showers until late at night. Freezing-point was reached at 2 a.m., and by daylight 8 or 9 degrees of frost was recorded. Apples were just past the fruit-set stage, and cherries were about the size of peas. An appreciable breeze was blowing, which prevented the smoke and heat from fire-pots rising more than a few feet. After daylight, clusters of cherries on the tops of trees were frozen together with ice formed from the rain on the trees when freezing commenced, but although the fruit was brown and shrivelled for a day or two it subsequently developed in the normal manner, with practically no reduction in the weight of crop.

Apricots were in full growth, and young shoots were defoliated and killed in many instances for the greater part of their length. The flesh of exposed fruit remained apparently firm or slightly shrunken externally, but internally was of a sponge-like texture with large open cavities.

Apples suffered severely, many orchards having not a single sound fruit left. Spurs which were carrying fruit turned brownish-black and waterlogged internally, only the centre of the wood remaining unaffected. The staining was general under the bark of the main limbs, and appeared likely to cause permanent injury. At time of writing, although the discoloration is evident, growth is coming away well from the old spurs, and the trees do not appear to be inconvenienced. Soft young shoots ceased growing for six weeks, the period of check being plainly shown by the short internodes and clustered disposition of the eyes, similar to the base of autumn second growth. It is remarkable that on these shoots podosphæra (powdery mildew) was general from the time of the check, while growths breaking from an old base since that date remain clean. In Cox's Orange only, mildew-infected foliage dropped almost immediately.

Pear wood proved less susceptible than apple, for whereas young growth from this season's grafts apparently softer than apple was not affected, growth on established neighbouring apples was cut back several inches. The general effect is that of a comprehensive summer pruning, and a heavy crop of laterals will be formed on this year's growth. Hard spurs have burst into growth, giving rise to some apprehension regarding next season's crop; but on present indications I consider that the elongation will not be excessive, and that fruit will be produced in sufficient quantities on the terminal buds.

—*G. H. McIndoe, Orchard Instructor, Dunedin.*

Correction.—Referring to the lists of select grape-vines imported, published on page 59 of the *Journal* for January last, the vines specified as received in exchange were from the Victorian Department of Agriculture, not from the South Australian Department as printed.

SEASONAL NOTES.

THE FARM.

Importance of Pasture Top-dressing.

DUE consideration having been given to the present general reduction in farm income, which makes it necessary to keep down expenditure as much as practicable, it may be said definitely that the wisest course in respect to our grasslands lies in the adoption for the coming few months of a top-dressing programme greater than has at any time been carried out in the past. The available evidence indicates not only that top-dressing may be employed generally to improve the farm position, but also that if it is not so employed the position on many farms will not remain stationary but will become appreciably worse.

In every extensive farming community there exists a section which was able to carry on in the past without resorting to top-dressing. In the changed present times a section which can carry on without top-dressing still exists, but in general it has become smaller. Some who have farmed, with satisfaction to themselves, with little or no top-dressing in the past, may attribute this mainly to one or both of two facts: Firstly, they were possibly working under exceptionally favourable circumstances, such as unusually low initial cost of land. Secondly, they certainly were gradually depleting their capital in that they were drawing off some of the original fertility of the land without taking any proper steps to replenish it. Their profits often would have been greater from the assistance of top-dressing, which now at times is essential if there are to be any profits at all.

These statements relative to the value of top-dressing are subject to two qualifications: Firstly, there are grassland areas for which top-dressing is not recommended. These, however, are exceptional, and any farmer should make sure that his own is one of the exceptional cases before he decides to carry on without the substantial assistance usually available from top-dressing. Secondly, the financial benefits to which reference has been made presuppose judicious expenditure on top-dressing. If top-dressing is not carried out wisely and linked up soundly with other aspects of pasture management, it may result not only in disappointing returns, but also at times in positive harm to pastures. Fortunately in New Zealand the main requirements of the top-dressing position are not so hidden as they seem to be in some other countries.

Phosphatic Top-dressing.

In general, the supply of available phosphate is the weakest link in the chain of crop requirements. Until this chain is strengthened in its weakest link production is unduly depressed. The deficiency of phosphates, though not universal, is very general in New Zealand soils; hence, as a rule, the primary consideration is the supply of phosphates. Until this has been placed in a satisfactory position it is seldom advisable to supply other top-dressing material. An occasional exception to this rule arises in respect to lime: sometimes phosphatic fertilizers will not function satisfactorily unless linked with liming. But as a general rule the first consideration should be phosphates.

Of the phosphatic manures superphosphate is most largely used. Field experience quite justifies this. Super as a rule excels all other phosphatic manures in localities of low rainfall, and in districts of high rainfall it will

generally at least hold its own with other phosphatic manures. It makes its influence felt more quickly than other phosphates. It is not nearly so temporary in its beneficial effect as some profess to believe; in carefully observed instances superphosphate has been functioning quite appreciably at twelve months and more after its application. Despite past teaching to the contrary, it is now definitely established that superphosphate does not cause any permanent sourness of the soil. To sum up, it may be said that super can be used over wide areas with the maximum of satisfaction—quick returns, high response, and reasonably long effect.

Next in importance to superphosphate, and of considerable moment, is basic slag. In the past on many farms splendid results have been obtained from the use of slag. In such cases it would be unwise to depart from its use, except on an experimental scale, until evidence had been obtained of superior returns from the top-dressing material with which it is intended to replace the slag.

In districts of good rainfall, African and similar phosphates may be expected to give good results, but, because of the comparative slowness of their action, they should not be used alone when an early response from the top-dressing is desired. Over wide areas a mixture of equal weights of one of these phosphates and of 44-per-cent. superphosphate is likely to produce good results on pastures.

It is not at all satisfactory to give general advice relative to the per-acre amount of phosphates that should be applied, for this depends upon many circumstances, including soil, climate, and financial resources, but some guidance is obtainable from the following facts: (1) Very satisfactory results have been obtained over wide areas from dressings of 3 cwt. an acre; (2) there are few, if any, recorded cases of phosphates being used in such excessive amounts as to be unprofitable on land which is known to respond to moderate dressings (say, 1 cwt. to 3 cwt. an acre); (3) generally, as experience of the results of top-dressing increases, the normal tendency is towards an increase in the size of the annual dressing of phosphates.

The Place of Potash and Nitrogen.

In certain districts, as, for example, in parts of Southland and Taranaki, official trials have given indication of definite responses from the use of potash on grassland. In districts in which such responses are being obtained farmers are justified in making fairly extensive trial use of potash. The use of potash should be linked with the use of phosphates, for the evidence points to a double deficiency in the soils of the districts concerned, and if this is not remedied the use of potash alone will be found unsatisfactory. Apart from the particular districts in which responses to potash have been noted in official trials, there is no evidence to justify recommending the use of potash in top-dressing generally. The material known as "30-per-cent. potash salts" is ordinarily the most economical source of potash for grassland.

In connection with dairying, autumn top-dressing of nitrogenous manures calls for brief mention. In those cases in which a shortage of winter feed is in prospect the use of soluble nitrogenous manure, such as sulphate of ammonia or nitrate of soda, in late March or April, at the rate of about 1 cwt. an acre, may be a useful emergency measure to increase the winter feed-supply. The use of such nitrogenous manures is satisfactory as a rule only in conjunction with the use of phosphates, which should be applied shortly prior to or at the same time as the nitrogenous dressing. Best results may be obtained from nitrogenous manures employed in the way just suggested by using them on fields which are well drained and which carry a sward rich in rye-grass.

Liming.

The matter of the liming of pastures is one about which advice is often given without any evidence to support that advice. The orthodox view of former times that liming is practically always economically sound cannot now be accepted. In New Zealand liming of grassland has produced very diverse results. Sometimes liming is obviously advisable; at other times it gives no apparent result. In view of this, expenditure on liming should not be incurred without evidence of success attending its use under circumstances similar in essential respects. Liming by itself is seldom financially attractive. It is as a rule unwise to resort to lime as a substitute for those more costly artificial fertilizers, such as superphosphate and basic slag, the worth of which has already been proved. However, if these latter manures are not giving satisfactory results the use of lime in conjunction with them is well worth a trial. The point probably of major current importance is that liming, as a cheap alternative to other top-dressing of proved value is, as a rule, false economy. It has already been remarked that liming is sometimes obviously advisable; when this is so, liming of course should be continued according to financial ability.

Autumn Management of Grassland.

Wherever pastures are known to respond satisfactorily, a special endeavour should be made to top-dress newly established grass. Sometimes young pastures deteriorate appreciably because of a slight initial lack of fertility, and it is usually more profitable to prevent early deterioration by means of suitable top-dressing than later on to renovate the swards which have suffered because of failure to top-dress in the early stages.

Generally autumn harrowing of pastures is very desirable. Whereas on new and vigorous swards the main purpose of the harrowing may be the thorough distribution of droppings, on the other hand, in the case of old matted swards in particular, it may be very desirable to secure sufficient penetration of the harrows to tear and aerate the turf. Both effects are so valuable that harrowing is now considered an essential link in the chain of practices constituting good pasture-management.

Winter and Spring Feed Measures.

The recent needed and general rains have brought a welcome change in the colour and growth of pastures over wide areas. In regard to feed for the coming winter and following spring, because of this change some farmers seem likely to become possessed of an unfounded feeling of security. The point of practical importance is that the changed appearance of the pastures is apt to be deceptive as to its effects on winter and spring feeding. While the extra growth that the recent rains ensure will be most valuable as a means of keeping up the condition of the stock prior to the difficult late winter and early spring period, it is desirable to bear in mind, firstly, that many farmers are facing the period mentioned with unusually low reserves of feed; secondly, that partly because of the possibility of early cold conditions, the growth of grass is not likely to be so substantial as current appearances would lead one to expect; and, thirdly, that, in any case, the growth is likely to be of a lush, immature nature, lacking the value for winter feeding that characterizes the more mature growth frequently available for winter.

These considerations indicate that much reliance cannot safely be placed upon the results from the recent rains, but that cropping measures suited to strengthen the feed position should generally be pushed on as much as possible. The most important step that may yet be taken in this connection is probably the sowing of cereals. If relatively early feed is definitely desired, barley or white oats should be employed, but in districts

where such oats suffer severely from rust they should be employed only if it is intended to use them simply as a catch-crop for green feed, and not to let them develop eventually into a grain or chaff crop. When early feed is not specially desired, Algerian oats—which rightly are popular for green feed—may well be used; they can be fed off and then used to produce good chaff.

Oats for winter and spring feed and subsequent grain or chaff production should, if possible, be sown not later than April or early May, and it will usually prove profitable to fertilize them with 1 cwt. to 2 cwt. per acre of superphosphate, while if the crop is to be grown on land exhausted appreciably by previous cropping it may be advisable to use ammoniated superphosphate, so as to correct to some extent the shortage of nitrogen.

For the purpose of building up the maximum possible supplies of winter feed care should be taken to turn into silage or hay, before frost injury has occurred, any available green maize or millet. Silage should be made in preference to hay if the green material available is not so small as to lead to undue wastage in ensilage.

Swedes attacked to any considerable extent by dry-rot should be fed without any avoidable delay. In using cereals for green feed better results are usually obtained by feeding off two or three times when the growth is not very tall, instead of waiting until there is a tall growth which not only is apt to involve relatively heavy wastage by trampling, but may lead to a poor second growth.

Seasonal Work with Lucerne.

Autumn work with lucerne is at times of importance. Occasionally the growth made during the latter part of the season is grazed. The trampling thereby incurred definitely favours the entrance of grass, hence such grazing is usually inadvisable in the interests of the lucerne. This is especially true of districts of good rainfall, in which grass may become such a strong competitor with lucerne as to become one of the worst weeds affecting it.

A lucerne area that has become infested with weeds often may with advantage be cultivated in April. The implement used for this purpose should be fitted with narrow tines to avoid as much as possible mutilation of the lucerne plants. Because of the mutilation it is likely to cause, disking is nearly always definitely inadvisable. Cultivation carried out so late as to exclude the possibility of any further considerable growth of the lucerne in the current season may frequently be followed with advantage by an immediate sowing of 1 bushel to the acre of Algerian oats. The oats not only check the development during winter of more permanent plants which would prove serious weeds of lucerne, but also give with the lucerne in the spring a heavy growth of well-balanced feed. It is highly desirable that plans should be made to utilize the spring growth of oats and lucerne for ensilage early in the season, for if it is left standing past the time when early ensilage is possible the oats may shade the lucerne to its definite detriment.

The Cereal Crops.

In the autumn much important work with cereal crops demands attention. In past March issues of this *Journal* considerable reference has been made to such matters as manuring and disease-control relative to cereals. During late years our knowledge relative to such matters has been added to substantially, and information as to the most effective practices may be obtained on application to local officers of the Fields Division.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Disease-control.

ALTHOUGH it may be considered that the main summer spraying programme is now about closed, in many orchards it is unsafe to say that it is completed. Where red-mite has not been effectively controlled, the application of an oil spray will materially assist in reducing the numbers of the pest to be fought next season. The prevention of "pin-point" spot must not be neglected, for with dewy nights this form of black-spot is quite liable to ruin an apple or pear crop and thus nullify all the previous work of the season. Lime-sulphur will act as an efficient protectant.

Where hygienic measures have not been applied during the season in assisting the control of brown-rot, much can still be done to reduce infection for next season. All affected twigs should be cut back into healthy wood, diseased and mummified fruit picked up from the ground and from off the trees, and the whole destroyed by burning. If this work is done now the diseased wood will be much more easily distinguished than if left until pruning-time. The need for these precautions will be appreciated when it is known that the new infection for the coming season comes largely from the affected twigs and mummied fruits.

Cultivation, Irrigation, and Cover-crops.

Those growers intending to grow cover-crops this autumn should not delay, if a good stand is to be obtained before the winter sets in. Cultivation, except for cover-crops, will now cease; but irrigation should continue late into the autumn to ensure a moist, but not wet, condition of the soil.

New Plantings and Replacements.

If it is intended to add to acreage growers must now make up their minds as to the numbers of each variety they intend to plant, so that orders may be immediately placed with nurserymen in order to avoid disappointment. When ordering, make a stipulation that only the variety asked for and on the required stock shall be supplied. Ask that you be notified immediately if the nurseryman cannot supply you with any of the trees ordered, at the same time advising you of any other varieties he may have in stock that might fill your requirements. This will give time to make a fresh selection or to try elsewhere.

In considering additions, replacements, or workings over, consider well what varieties or classes of fruit you will obtain. The work of the picking season must be considered so that it can be reasonably well spread out; the filling of a gap, especially in stone fruits, between one variety and another is very desirable, so that your fruit may be before the public for as long a period as possible. The suitability of the variety to local conditions and to market requirements must also be seriously considered before ordering.

There is also the questio[illegible]ss replacements. Trees may be seen that have not been profitable for [illegible]n[illegible], and it is difficult to conceive how they have been allowed to encu[illegible] the ground for so long. They should be rooted out and replaced by more profitable trees. In some of the older orchards varieties are somewhat mixed, which makes almost every operation in the orchard difficult. In replacing these, endeavour to gradually eliminate the old trees by planting to a system that will gradually give a block of one variety. Much can be done in this way to ease the general work of the orchard.

Miscellaneous.

Export work will now be at its height, and only if attention is given to the details mentioned in last issue can a successful pack be expected.

The points suggested are equally important for the grower who intends to place his fruit in home or cool storage for supplying the markets during the winter and spring months.

Buds recently inserted should be examined, and if the leaf-stalk easily falls away when touched one may be assured that they have "taken"; but if the stalk persists and there is evidence of a shrinking of the buds, two or three weeks after the insertion, they will almost certainly have missed. Where it is considered that the bud will not survive, it is worth while to take the risk of the lateness of the season and immediately insert another, if possible below the previous working. Bands which have not been cut should be watched, and any tendency for them to cut into the stock avoided by cutting the tie as previously advised.

—*W. R. Lloyd Williams, Orchard Instructor, Alexandra.*

Citrus Culture.

Cover-crops: The recent rains will have put the soil into good condition for the sowing of green crops for ploughing under later in the season. Those plants that produce the greatest amount of growth in the shortest possible time are the best for this purpose. In order to stimulate growth it is advisable to make the sowing of the seeds coincide with the application of some fertilizer, which should be applied during the autumn. Soils that are rich in organic matter cause the trees to grow more readily, and, moreover, in a measure help the trees to resist some of the diseases now so common. Green crops of various kinds, if grown each season, must eventually help to improve the mechanical condition of the soil. Quick-acting artificial fertilizers are useful, but they can never make up that deficiency which alone can be supplied by organic matter.

Where any working of the soil is carried out prior to the sowing of cover-crops, it should all be done with the view to making a slight slope away from the trees. There is nothing so injurious to the root-system of almost all fruit-trees as stagnant water. If care is exercised in the direction indicated losses will not take place through the land becoming waterlogged.

Brown-rot: The yearly loss from brown-rot is a serious matter, and varies in severity according to the rainfall. Preventive measures should be taken in the direction of cutting away any branches that touch the soil. In some quarters it has been found that treating the soil with a light dressing of sulphate of iron has a very beneficial effect in checking spore development. Although it is doubtful whether any complete remedy can be found if there is a long and continued period of damp and humid conditions, growers should be seized with the necessity for taking every reasonable care in regard to this disease. Possibly one of the principal factors is good sanitary conditions throughout the orchard.

—*L. Payn, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Management of the Pullets.

If the pullets, particularly those hatched on the early side, are to succeed in their future function of producing winter eggs, it is of the first importance that they receive uniform care and attention in every respect. Otherwise the birds are almost sure to go into a premature moult, which means that the energy which should have been devoted to the production of eggs will go to the production of new feathers. All possible steps should be taken to discourage the birds from going into an early moult.

In the first place there should be no violent change in the system of handling and feeding. The birds should be placed in their winter quarters before their laying period commences. Further, they should not be suddenly placed on a heavy meat diet—in fact, there should be as little change in the diet as possible. Meat should be introduced gradually to the ration as the birds show indications of starting to lay. Where possible, the winter layer should at all times be fed under shelter and not be compelled to wait about in a cold wet yard for food. If winter eggs are to be secured in good numbers the floor must be well covered with straw litter so that the birds may exercise in comfort by being compelled to scratch for their grain ration during cold and wet weather.

As regards the quantity of food necessary for a given number of fowls, no definite rule can be laid down. The birds should be given as much as they will eat at each meal without waste. The good layer will not eat more than she requires if fed regularly, and will turn the food into eggs, while the poor layer will turn it into fat. A bird that has to be fed a reduced ration in order to prevent her from becoming too fat, while provided with ample means to exercise, should have no place in the run where heavy egg-production is the object. The good layer is generally active, and does not fatten as quickly as does the drone. An ample supply of animal food, such as meat or meat-meal, is necessary for promoting winter egg-production. The good layer will consume much more oyster-shell than the drone; hence in a heavy-laying flock there should be no stint of this or other sea-shell for an egg-shell forming, otherwise a high proportion of weak-shelled eggs will result.

Non-laying Ducks.

Several complaints have reached me of late regarding Indian Runner ducks going into a moult and not laying up to expectations. In some cases the owners have adopted the plan of changing the food, being under the impression that the food previously supplied was responsible for the birds moulting and their failure to lay. This, however, does not necessarily apply, as it is quite common for ducks, even when they receive proper food and management, to moult twice a year—about February and again in June or July.

Ducks that have been well fed and managed, and which have had a good egg-yield previous to moulting, should not have their ration changed, as this would only make matters worse. A bird will always come back to laying condition much quicker when there is no alteration in its treatment. The treatment being given may not be quite right, but any sudden change will not improve matters. Any contemplated change in the ration provided should be introduced by degrees. Ducks are usually of a very nervous temperament, and any alteration in the method under which they are kept will cause them to fret, thereby intensifying any unfavourable condition to which they have been subjected. That laying ducks require frequent changes of food is one of those theories which fails lamentably in practice.

Ducks are creatures of habit, and therefore a change of quarters will have an equally bad effect on the egg yield as a change of food. Fright caused by the presence of hedgehogs, ferrets, &c., will often upset ducks, and this will be followed by a false moult and failure to lay. The lights from motor-cars, &c., will also often have this undesirable effect. For this reason ducks should be kept as far away from the road as possible. Even then the house in which they are kept should be arranged in such a way that the lights from cars cannot shine brightly into it. It will usually be found that the greater the number of ducks kept in a flock the greater will be the risk of their frequently moulting and ceasing to lay when subjected to changes of food and quarters. It will thus be seen that if the laying duck is to produce eggs to its maximum capacity the matter of uniform treatment in every branch of its management is imperative.

Feeding and Breeding Considerations.

In view of the present high cost of food and the low prices ruling for eggs, many poultry-keepers are naturally looking for every means of economizing in the food bill Unfortunately, many are inclined to economize in the wrong manner by using cheap substitutes for recognized good foodstuffs, or in not giving their fowls sufficient food, while they are also apt to lend a willing ear to the advice of neighbours and others who have some new idea for feeding poultry.

The most common fallacy in this direction is the foolish advice which is being so freely advocated that chickens cannot be successfully reared, and that adult stock cannot be maintained in a sound healthy state and produce a paying egg-yield, nor have the power to ward off disease, unless certain stimulants, tonics, chemicals, &c., are added to the ration provided. I am repeatedly being called upon, particularly by inexperienced poultry-keepers, for advice as to the value of one or other of these materials, but seldom are inquiries of this nature received from successful men in the business. These men realize that if stock are to be maintained in a vigorous healthy condition (and they can be profitable only if they are healthy) sound breeding, feeding, and general good management are the great underlying principles on which to work. They realize that pampered stock can never give a good account of themselves, and that if a high proportion of weakly stock is being produced the methods of breeding, feeding, and general management are not what they should be. In view of the fact that stock could be successfully reared and maintained in a healthy and high-producing condition many years ago without the aid of chemicals, &c., there is no reason why this should not be the case to-day, providing common-sense methods of management are resorted to.

It may be true that many strains of laying stock are manifesting signs of deterioration in size of body and constitutional vigour, and that as a result their progeny are difficult to rear, while even many that are brought to maturity rarely develop into highly profitable stock. The great underlying principle in breeding the modern layer is to see that no bird, whether male or female, is placed in the breeding-pen unless undoubted constitutional vigour is possessed. But this is not enough; the progeny must be given every opportunity of securing a liberal supply of natural food and be reared under natural conditions throughout the growing stage. Next in importance is the question of cleanliness. The houses must be maintained in an absolutely sanitary condition, while the yards must not be allowed to become stale and a breeding-ground for disease and parasitic life. A thoroughly clean run is just as important as a thoroughly clean house. In fact, cleanliness is essential in everything connected with poultry.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Autumn Operations.

By the time these notes are in print the month of March will be well advanced, and beekeepers will be fully occupied in doing the last of their honey-extracting and preparing their colonies for the winter. Should the autumn be mild, final extracting may be later than usual on account of a prolonged flow of nectar. Thistles will probably yield more nectar at this period than other plants, and will, when mixed with clover or catsear, produce a white, clear, and delicately flavoured honey which forms a splendid exporting article.

Should late extracting be necessary, great care must be taken to check robbing; an apiary may soon become demoralized if precautionary measures are not taken. When once robbing starts it may prove a difficult matter to stop. Thousands of bees may be killed by endeavouring to enter the wrong hives, and thereby the strength of the colonies be very much weakened; or the colonies may even be rendered incapable of going through the winter. When robbing has commenced, do not open any more hives until the trouble is controlled. This may be done by syringing the entrances of the offending hives with water, and in bad cases by placing wet grass over the entrances until the disturbance has been quelled. Do not on any account leave combs of honey open to attack, or keep a hive open an instant longer than necessary. If the colony attacked is weak contract the entrance in addition to the above-mentioned precautions. It may be necessary to suspend work in the apiary during the day, doing as much as is thought advisable in the early morning.

Foul-brood.

At all times of the year foul-brood is a menace to the beekeeping industry, and it is advisable to always keep a sharp lookout for any symptoms. This is especially the case during the spring and autumn months; and before pronouncing any colony fit for wintering the brood-nest should be carefully examined for the slightest sign of the disease. If a trace is discovered, or the disease is found in a more advanced state, judgment must be used as to the advisability of destroying the colony completely or of treating it.

Winter Stores.

As advised last month, do not fail to determine the quantity of stores available in the hives for winter consumption. A plentiful supply is sound economy, and my advice is that not less than 30 lb. of honey be left in each hive. There are occasions when late swarms have not gathered sufficient for their own wintering purposes, and then they must be fed either with clean healthy honey or with sugar syrup. Never use honey from an unknown source for this purpose.

Cleanliness and Order.

Before finally leaving the hives for winter it is a good plan to scrape the bottom-boards free of all the rubbish that has accumulated during the summer, thereby helping to keep the bees in a healthy condition. Also scrape the alighting-boards clean, and clear any long grass surrounding the hives; this will tend to keep away dampness. The hives should be placed on blocks several inches off the ground, and in a sheltered position where they may receive a considerable portion of the day's sunshine. Any leaky covers or split supers should be removed from the hives, and sound ones put in their place. Remember bees require dryness and warmth.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Bean-wilt Disease.

BEAN wilt was found last season attacking dwarf and runner French beans in the middle districts. Infected plants are now being sent in from many localities, with inquiries regarding the cause of the trouble and advice on treatment.

An article on this disease, which has been named *Phytomonas medicaginis*, appeared in the December number of this *Journal*. Some of the main facts which should be remembered are that it is caused by bacteria, parasitic vegetable organisms of microscopic dimensions—a class that is always

difficult to control when they attack crops. A specially insidious feature in the case of an attack by *P. medicaginis* is the fact that the symptoms are in no wise remarkable, for which reason many crops are found badly affected and the owner is quite unaware that a serious disease is present, the disfiguration usually being attributed to a recent storm, and the hope entertained that the crop will grow out of it. As one of the most important operations in control is to carefully burn infected material so soon as it is observed, the delay gives the disease every opportunity to spread through the crop, and even to be carried to others in the vicinity.

When attacking the leaves, the first symptoms to be noticed probably are the brown spots of various sizes and irregular shape that afterwards run together and become brittle, the progress usually being checked as the base of the leaf-stalk is reached. This condition is also common to other causes; but the reddish-brown lesions often found on the stems are more distinctive, and, like those on the leaves, make slow progress downwards; so that the base of the plant may be comparatively vigorous and sound, while the upper parts are more or less brown, shrivelled, and dry. Infected spots on the pods leave little doubt regarding identity; the isolated rounded water-soaked areas that afterwards become brown and dry are the most distinctive feature of this disease.

From this description it will be noticed that the bacteria do not spread through the tissues to any great extent, but the separate infections are numerous. These infections are caused by a thickish liquid which slowly oozes from infected areas; it becomes diluted and falls or is brushed on adjoining tissue, which may become infected even when the surface is unbroken. From this it is easy to understand how important it is to carefully pull and burn infected plants, or the traffic during cultivation and harvesting, especially on dewy mornings or after rain, will spread the disease rapidly through the crop—and even other crops of beans if they were visited while one had the bacteria in liquid suspension on hands or clothes.

An excellent method of burning such material was seen recently where a grower had a large 40-gallon oil drum with a few firebars fitted and an opening made for draught and lighting. The idea was to set it up in the middle of a cleared space in the infected crop, place a good bundle of inflammable twigs on the fire-bars for kindling, and then pack the drum carefully with the infected material. With a little adjustment, or delay perhaps, to allow the material to dry out to some extent, the diseased material is effectually destroyed without trailing the infection. In this way, by using the greatest care and avoiding that area when beans are being planted next season, the trouble may be controlled.

There is, however, a danger of introducing the disease again—as it was probably introduced before—by planting infected seed. Such seed may have pale yellow blotches on the surface, although all discoloured seed is not affected with this disease. Also in the case of coloured seed this stain may not be noticeable, or seeds lying beneath an infected area in the pod may be infected without showing stain or becoming shrivelled. All this makes it very difficult for the seedsman, for, however careful he may be, it is not possible to guarantee that a large area in crop is absolutely free from this disease. As there is no way of treating the seed effectually, the grower has to take this risk, and overcome it by using clean land and keeping a sharp lookout for any sign of trouble, and deal with it promptly if it should appear. If one has clean stock of good strain it should be maintained and guarded with the greatest care, for such stocks are already becoming rare.

Vegetable Crops.

The winter crops will now be coming to maturity. They include celery, leeks, cauliflower, broccoli, brussels sprouts, savoy cabbage, and

kale; and many root crops are ready to be harvested. As parsnips rather improve in frosty weather they are left in the ground until lifted as required. Autumn-sown carrots and beetroot also keep in best condition under this treatment in the warmer districts. Main-crop carrots require to be lifted, or they split and become woody and lose flavour

The late potato crop should also be lifted and stored. In warm localities there is serious danger of the crop making a second growth if this operation is delayed. In such places the crop must be lifted promptly so soon as it reaches maturity. There are too many bad-flavoured and flavourless potatoes about, due to neglect in this respect. Crops should be lifted only in fine weather, and those dug should be graded and stored—or at least bagged up—before night. The crop should be carefully studied, and a proper estimation of its quality and condition so obtained. If it is good and sound the crop is worth storing for later use or consigning to the more distant markets. The pickers should be instructed and supervised in respect to sizing and the rejection of broken tubers. This opportunity is often missed, and good and bad, large and under-sized, are mixed together, to be sorted later at great expense and after the spores of disease have been well distributed through the stocks. All this expense and loss could be avoided by giving more attention at the first handling. If the quality of the crop is only fair and the condition variable, no attempt should be made at long storage. It is not worth the cost, and such a crop should be graded to best advantage and put to immediate use. Stocks of good quality and sound condition are suitable for long storage, but it must be of the right kind. Such conditions are clean, dark, humid, and cool storage, with little variation in temperature. Too often the first condition is lacking, owing to diseased and pest-infested rejects of past crops being left in the vicinity. An elementary knowledge of the life-histories of parasitic fungi and insects proves that reasonably clean habits are essential, especially where perishable produce is to be kept for comparatively long periods.

An important operation in most localities at this season is the planting of crops of cabbage and cauliflower for spring cutting. For these crops the land should be well drained and moderately well supplied with farm manure. Harrow in a good dressing of lime, and when a good tilth has been obtained mark out the rows and set the plants carefully, deep and firm. Light, shallow, hasty planting is quite a common cause for unsatisfactory crops. Another vain hope is to expect to get a good, even crop from a mixed lot of plants, when it can only be obtained by setting out plants carefully selected from the seed-bed.

As soon as the foliage on the asparagus crop ripens it is customary to cut it down to the surface of the ground and burn it. Then apply a dressing of partly decayed farm manure—as may be necessary to maintain the supply of humus—and plough it under.

Glasshouse Alterations and Repairs.

Now is the time to carry out any good resolutions made regarding such work. Many growers in the warmer areas will have made up their minds that more ventilation is required along the ridges of the houses, and now while the houses are empty is the time to carry out the work. Most houses in districts subject to occasional hot humid weather would benefit greatly by such an increased facility. An important feature in the construction of these ventilators is the hinges. As they are too inaccessible to be kept oiled, it is important they should be strong and not subject to corrosion.

To attend now to any necessary repairs in the way of painting or glazing may be taken as a matter of course, for once the water gets into the sash-bars and plates deterioration is very rapid. This is most likely to occur in the upright side-walls of a house, due to unsatisfactory construction

of the eaves, where the sash-bars of the roof are cut off short and nailed down on a flat top-plate which holds the storm-water, and allows it to filter down the wooden parts of the side-wall to rot the sill (which also generally has a flat top) and finally make the ground wet and cold for a couple of rows of plants nearest the side-walls in the house. Where this is the position it will generally pay to affix guttering in such a way that all the roof-water is collected and run into a tank, thus reducing depreciation and making at least a 10-per-cent. improvement in the crop. This may be done more easily before building by having the tops of plates and sills properly bevelled. If grooves are also made where necessary to prevent water soaking in beneath and keeping the underside wet, the life of the house will be greatly lengthened.

Planting Strawberries.

The planting of strawberries should now be done where the preparation of the land has been successfully accomplished. Obtain hardy, strong plants of a good strain of a variety suited to the locality. It is not sufficient to plant just strawberry-plants, even if they are big ones. It is important that they should be of a variety suited to local conditions. Not only that—for best results they should be of a good strain, for this plant, like other kinds after years of vegetative propagation, is apt to lose some of its most valuable characteristics and to deteriorate, unless careful selection is practised when propagating.

So soon as the plants arrive they must be unpacked, stood out in a single layer in a shady place, and watered, to cool and harden, as large quantities often become heated on a long journey.

If in the later stages of the preparation of the land a generous dressing of bonedust has been turned well under, an ounce or two of superphosphate per square yard, harrowed in a few days before planting, will be sufficient fertilizers at this stage under average conditions.

The land should then be smoothed out, marked, and planted. Here again the danger is in planting too high and lightly. In a friable soil the plants should be put in firmly with the top of the crown level with the surface of the land. Where the one-year cropping system is adopted, the spacing is usually 9 in. between plants and 27 in. between rows. Where three- or four-year cropping is practised these distances may be increased slightly. The land should be allowed to settle down and consolidate before planting.

The Homestead Garden.

In the descriptions of native trees suitable for the homestead garden that have been given in these notes recently nothing has been said about *Hedycarya arborea*. From the bush in Hawke's Bay a specimen bearing a handsome bunch of fruit was submitted recently for identification, and its very fine appearance proclaimed definitely that it is certainly worthy of consideration for planting in the homestead garden. It happens to be one of those small trees of about 20 ft. to 30 ft. high that are so useful about the homestead, but are quickly destroyed in the bush by browsing stock, so that they are rarely seen to advantage. In semi-shade, which suits the tree best, the orange-red, shapely fruit shows up very handsomely among the richly toned evergreen foliage. There are separate staminate and pistillate plants, the latter only, of course, bearing the fruit. The hardy porokaiwhiri, or pigeon-wood, has an unsuspected beauty when it is grown, as was the plant from which this specimen was taken, in natural bush from which browsing animals have been excluded.

Where planting is to be done the preparations should now be advanced as quickly as weather permits, as the short planting-season—that is, the season suitable especially for setting out hard-wooded plants—commences towards the end of May, and in most cases early planting gives by far the best results.

—*W. C. Hyde, Horticulturist, Wellington.*

WEATHER RECORDS: FEBRUARY, 1932.

Dominion Meteorological Office.

THE weather of February was remarkable for the complete break in the drought which had prevailed in many districts during the preceding months. During the second and third weeks two spells of heavy rain occurred. In the first, the area principally affected was in the eastern portion of the North Island from Cook Strait to East Cape, the falls being particularly heavy from Hawke's Bay northwards. The second rainy spell was between the 17th and 22nd. On this occasion the whole country benefited, heavy falls being practically universal, including Canterbury, Marlborough, and the Manawatu.

Rainfall.—The amount of rain for the Dominion as a whole must have approximated 50 per cent. above the average. In eastern districts between Oamaru and Timaru, from Wellington to East Cape, and about Auckland and the Coromandel Peninsula, many stations recorded more than double the average for February, and some three or four times that amount. Nevertheless, parts of the Auckland Peninsula, most of Taranaki, and parts of Southland and of the interior of Otago, had less than the normal.

Temperature.—In most places temperatures were below the normal for February, but in the interior the departures were seldom marked, and some inland parts of the North Island were warmer than usual.

Sunshine.—The amount of bright sunshine was much below average. Indeed, in many places it was the cloudiest February on record.

Storm Systems.—At the beginning of the month there was a continuance of the series of westerly depressions which had been passing rapidly across the Dominion. On the 7th, however, a tropical cyclone developed in the neighbourhood of Fiji. Moving southwards during the next few days it became very deep and extensive. This storm controlled the weather in New Zealand until the 15th. Rain commenced on the 7th or 8th, and from then on until the end of the period most of the North Island, except Taranaki and western Wellington, received good rains, with many heavy falls. The heaviest were from Cook Strait to East Cape, and especially from Hawke's Bay northwards. The 9th and 13th were the wettest days. A record flood occurred on the Poverty Bay flats on the 10th. During all this period south-easterly winds prevailed over the North Island, gales being reported at many stations. Towards the end the weather became cold.

The storm responsible for the above-mentioned rains had moved away eastward by the 15th. The weather remained sultry and humid, and everything was favourable for renewed rains should a disturbance develop. For some days, however, pressure variations were slight and rain was rather sporadic in character, thunderstorms occurring in many districts. On the 19th a cyclone moved from near Lord Howe Island just past the northern extremity of New Zealand, and its centre was east of Russell on the morning of the 20th. Strong north-north-easterly winds were caused all over New Zealand, and especially along the east coast. During the night of the 19th there were very heavy rains in North Otago and South Canterbury, and record floods occurred between Hampden and Timaru. The rain continued on the 20th, practically the whole Dominion, except parts of Otago and Southland, recording heavy falls. The number of totals on the 20th which exceeded 2 in. was remarkable. Many rivers were flooded in both Islands. The storm did not disappear from our weather charts until the 24th.

The month finished with another spell of westerly weather.

RAINFALL FOR FEBRUARY, 1932, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average February Rainfall.
	North Island.				
		Inches.		Inches.	Inches.
1	Kaitaia	2·28	7	0·84	3·59
2	Russell	4·40	7	1·82	2·78
3	Whangarei	1·99	8	1·08	4·00
4	Auckland	7·51	15	3·74	3·04
5	Hamilton	2·97	10	0·81	2·97
6	Rotorua	3·27	11	0·89	3·78
7	Kawhia	3·34	11	0·61	2·79
8	New Plymouth	3·04	12	1·23	3·87
9	Riversdale, Inglewood	4·06	10	1·15	6·14
10	Whangamomona	2·50	6	1·05	3·92
11	Eltham	3·92	11	1·81	3·21
12	Tairua	10·56	9	4·52	4·11
13	Tauranga	4·95	10	2·88	3·40
14	Maraehako Station, Opotiki	6·07	13	1·20	3·44
15	Gisborne	12·01	13	3·86	3·31
16	Taupo	3·23	10	1·49	2·79
17	Napier	6·20	18	1·48	2·81
18	Hastings	5·70	15	2·51	2·87
19	Taihape	3·62	11	1·71	2·24
20	Masterton	3·79	15	1·33	2·76
21	Patea	1·72	6	0·75	2·50
22	Wanganui	2·87	7	2·50	2·44
23	Foxton	3·25	8	2·50	2·11
24	Wellington	6·71	13	2·35	2·67
	South Island.				
25	Westport	8·03	17	1·97	5·35
26	Greymouth	6·71	12	1·78	6·10
27	Hokitika	9·68	12	2·13	7·22
28	Ross	11·95	9	3·55	8·85
29	Arthur's Pass	9·52	9	2·37	9·56
30	Okuru	18·16	13	8·08	8·72
31	Collingwood	5·52	9	1·42	5·24
32	Nelson	4·64	10	2·61	2·64
33	Spring Creek	3·39	10	2·40	2·22
35	Hanmer Springs	3·32	11	0·79	2·90
36	Highfield, Waiau	2·82	7	1·18	2·63
37	Gore Bay	5·15	8	2·07	2·76
38	Christchurch	2·95	8	1·34	1·73
39	Timaru	3·82	12	1·50	1·77
40	Lambrook Station, Fairlie	2·46	10	0·81	1·82
41	Benmore Station, Clearburn	1·80	10	0·90	1·33
42	Oamaru	4·35	13	1·30	1·73
43	Queenstown	1·23	12	0·36	1·95
44	Clyde	1·09	8	0·26	1·04
45	Dunedin	4·30	14	1·08	2·74
46	Wendon	4·27	8	1·20	2·04
47	Gore	..	..	..	2·65
48	Invercargill	3·75	17	0·85	2·99
49	Puysegur Point	4·25	16	0·72	5·76
50	Half-moon Bay	3·03	14	0·46	4·21

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.

TREATMENT FOR BLINDNESS IN SHEEP.

W. RICHARDS, Wairoa :—

I should be glad if you would give me some information regarding the treatment of blindness in sheep. Within the last two or three weeks I have noticed several cases in both lambs and older sheep. These cases have all occurred since the breaking of a long spell of dry weather followed by an unusually rapid growth of grass. The eyes of the sheep affected are covered with a white film. to disperse which I have tried an application of sugar but without satisfactory results

The Live-stock Division :—

Blindness in sheep is not uncommonly met with at this season of the year. This condition, known as ophthalmia, has been shown to be transmissible from one animal to another by direct contact with the discharge of an affected eye. It is therefore advisable to isolate the affected animals and confine them in a level paddock without creeks or gullies in order to prevent them from injuring themselves. If any green feed is available, affected animals should be moved to such pasture. Green succulent young feed of this kind has effected recoveries without further treatment. At the same time, if only a small number of sheep are affected, the eyes should be bathed twice daily with a tepid boracic acid solution. If a large number are affected, the following lotion has been found very effective: 1 oz of laudanum, 2 drachms of sulphate of zinc, with 1½ pints of pure water. The lotion may be instilled in the eye as the sheep pass through the race, a small sewing-machine oil-tin being found very useful for the purpose. A little pressure with the thumb on the bottom of the tin injects a few drops, and there is no waste.

PASTURE MIXTURE FOR HILLY CLAY SOIL IN HELENSVILLE DISTRICT.

R. B. WEST, Helensville :—

I have some 20 acres of fairly steep ploughable gum country, situated about three miles north of Helensville, that I wish to sow down in permanent pasture this autumn. The land is fairly heavy clay land facing the west, and thus liable to dry up fairly badly in the summer. Could you please tell me what would be a suitable grass mixture. We intend to sow with a little Algerian oats for winter feed.

The Fields Division :—

A suitable permanent-pasture mixture for a hilly clay soil in your district is as follows: Italian rye-grass, 5 lb.; certified perennial rye-grass, 20 lb.; paspalum, 5 lb.; crested dogstail, 3 lb.; cocksfoot, 5 lb.; red clover, 2 lb.; white clover, 2 lb.; Lotus major, 1 lb.: total, 43 lb. per acre. Perennial rye and white-clover seed sown should be certified seed. Paspalum should be Australian hand-shaken seed with a germination of not less than 35 per cent. The sowing of oats with permanent grass is not recommended on North Auckland clay soils, as the heavy stocking in early spring when feeding off the oats usually puddles the surface soil, which will then bake hard during dry summer weather. It would be best to sow oats in a separate piece of land.

TREATMENT FOR TAPEWORMS AND DISTEMPER IN DOGS.

"DISTEMPER," Gisborne :—

(1) Would you kindly tell me the way to rid sheep-dogs of worms. Does areca-nut if used more than once have a harmful effect on a dog's stomach? (2) What treatment (practicable on a station) do you recommend for dogs suffering from distemper? Is there any certain inoculation against it?

The Live-stock Division :—

(1) Station dogs are liable to become infested with tapeworms from eating uncooked offal obtained when sheep are slaughtered for home consumption. The most common drug used on stations for the eradication of the tapeworms is powdered areca-nut; the dose being gauged by using 2 grains per pound weight of the dog. It is advisable to buy the nuts and have the powder freshly ground before use. The dog is fasted for twenty-four hours before dosing. It is usual to give a dose of castor-oil or other laxative some hours after the powder Areca-nut is not satisfactory for the eradication of round worms in young dogs, other drugs being used for this purpose. There is no evidence that areca-nut powder is harmful if repeated at intervals.

(2) The treatment of dogs suffering from distemper resolves itself into a treatment of the symptoms as they arise. Good nursing is one of the outstanding points, the animal being provided with a warm dry bed and clothing if necessary, at the same time being provided with fresh air (not draughts), and given easily digested nourishing food, such as beef-tea, &c. Certain drugs may be used to assist the nursing, but the latter must be very largely depended upon. The symptoms may be those of pneumonia, when nursing plays a prominent part. Again, gastric symptoms may be present, when milk food should be given accompanied by salol or other internal antiseptic. Jaundice may be in evidence, and nervous symptoms are quite commonly seen. Good nursing is the sheet anchor in treatment of affected cases. A preventive vaccine against distemper has been prepared in Britain, but has not been wholly satisfactory. The vaccine is being improved upon, and when proved reliable will be imported into New Zealand

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DESTROYING CONVOLVULUS IN VINERY.

"INQUIRER," Blenheim :—

I have a grape-house that is infected with convolvulus, and I have been nformed that it can be destroyed by dressing it with a 5-per-cent. solution of sodium chlorate. Would the sodium chlorate have an harmful effect on the vines ?

The Horticulture Division :—

A solution of sodium chlorate would destroy all vine roots it came into contact with. Under the circumstances it would be preferable to dig out the convolvulus roots with a fork as soon as the vine leaves have fallen. Any slight damage done to the vine roots while the vines are in a dormant condition will have very little or no detrimental effect on the future crops.

USE OF MEAT-MEAL IN CALF FEEDING.

G. T. HUTCHENS, Motu :—

Will you kindly give me information about feeding calves on meat-meal—the amount, and how long they have to be fed on new milk and new with half-skim, before the meat-meal feeding starts.

The Live-stock Division :—

The use of meat-meal for calves was primarily intended as a supplement to the food of calves being fed whey, but has also been used successfully with skim-milk-fed calves. The quantities of meat-meal used in the latter case are smaller than when whey is used. The calf is given whole milk for a period of nine days, after which skim-milk is added, the whole milk being gradually reduced until at twenty days of age the calf is receiving all skim-milk. Meat-meal is added on the tenth day (the first day of the skim-milk) at the rate of ¼ oz. per head per day, the amount being increased by ¼ oz. every two days, until at the twenty-sixth day the calf is receiving 2 oz. of meat-meal per day. The calves are fed twice daily, and a chart has been sent you giving the quantities in full detail. It is advisable to use a salt and lime mixture in conjunction with the meat-meal feeding. The mixture is prepared by mixing equal parts of slaked lime and ordinary salt. None is given for the first two weeks, then half a teaspoonful per feed for one week, gradually increasing to two teaspoonfuls per feed at five weeks.

KILLING WILLOWS WITH POISON.

"WILLOWS," Southbrook :—

Could you tell me the best way of killing willows. The roots are spoiling the garden, yet I would like the stumps left in the fence line and intend growing climbers over them. I have heard of killing trees with sulphuric acid or weed-destroyer.

The Horticulture Division :—

Willows can be destroyed by injecting a weed-killer, as you suggest, and no time for the operation is better than when the trees are in full growth. Bore holes in the trunk in a sloping direction with an auger, fill them with the chemical, and then plug them to prevent evaporation.

DRENCH FOR INTERNAL PARASITES IN SHEEP AND LAMBS.

"DRENCH," Eltham :—

Please advise which is the best drench for lambs and sheep. I think most of us use bluestone. I have occasionally found tapeworm in a sheep killed for mutton. Do these worms affect the condition of the sheep? Is it worth while drenching the grown sheep to remove them? How long do you recommend starving sheep before drenching?

The Live-stock Division :—

Bluestone solution has been shown to be both as effective and as safe for the treatment of parasitic infection in lambs and sheep as any other drug. Comparative tests have been carried out with bluestone, carbon tetracholoride, and other drugs, and the results show that no drug is 100 per cent. effective in the eradication of all intestinal parasites of sheep. In the tests the bluestone solution gave as reliable results as any other drug and is proved to be effective against the large stomach-worm. These drugs are not intended as agents to be used against the tapeworms, their use is primarily for the small round worms. Tapeworms do not appear to affect the condition of sheep, and treatment against them is not as a rule adopted, nor does such treatment appear to be warranted. The recommendation in regard to fasting sheep before drenching is a period of twelve hours. This may appear unduly long in the case of weak or emaciated lambs, when the period of fasting may be cut down to suit the case. Better results are obtained, however, when fasting for twelve hours is adopted. The bluestone solution is prepared by dissolving 1½ oz. to 2 oz. of bluestone per gallon of water. The dose varies from 6 fluid drachms for lambs to 3 fluid ounces for adult sheep. Care is necessary when dosing sheep with any fluid drench.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 18th January to 10th March, 1932, include the following of agricultural interest :—

No. 66056: Driving-means for milking-machine pulsator; S. Oldfield. No. 67304: Hay-stacking appliance; D. McL. Wallace, Ltd. No. 66053: Testing and grading eggs; A. Turner. No. 68180: Shearing-machine; J. A. Richardson. No. 68236: Disk plough; E. A. Davis. No. 68285: Butter-divider; J. Benz. No. 65654: Deodorizing cream and milk; Te Aroha Dairy Co., Ltd. No. 65988: Shearing-machine comb-plate; J. J. Bourke. No. 66133: Wool-hoist; J. Fairweather and W. R. Fairweather. No. 66805: Tomato-house construction; M. H. Hannaford. No. 68094: Teat-cup; C. H. Davis. No. 68427: Producing soluble phosphate; Phosphate Acidulating Corporation. No. 66224: Repacking wool into bales: Abraham and Williams, Ltd. No. 66239: Stock-feeder; J. R. Irvine and G. Nicol. No. 66336: Wire-coiling appliance; T. H. Smith and W. J. Hart. No. 66655: Spraying-apparatus; E. Hope. No. 66731: Cheese-press hoop; C. N. Webby. No. 66786: Hay-stacker; Newton King, Ltd. No. 68238: Cattle-controller; H. V. Dyke.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

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BUTTERFAT PRODUCTION IN NEW ZEALAND.

FACTORS INFLUENCING UNIT-AREA PRODUCTION, WITH SPECIAL REFERENCE TO MILK-TEST.

E. J. FAWCETT, Farm Economist, Department of Agriculture, Wellington.

INTRODUCTION.

THE standard of butterfat production per unit of area farmed is generally accepted as the measurement of production efficiency under any given set of circumstances. As a standard of measurement this is fundamentally correct, since, when used in conjunction with maintenance and working costs, a final picture of the degree of management efficiency is obtained for the conditions subscribed. The standard of production attained, unfortunately, does not disclose the organization responsible for such a standard. Similar results can be procured from a variety of combinations, the component parts of which may or may not be balanced to ensure full exploitation of potential production.

It has been repeatedly impressed upon dairy-farmers that the most effective method of reducing unit production costs under any capital position is to obtain a greater volume of output per unit of area farmed. This is particularly true where the object may be achieved by a re-adjustment of production factors rather than by a gross increase in working expenses. Undoubtedly the most certain cost reduction resulting from production increase is in the spread of capital costs. It is significant, however, that under the semi-static conditions prevailing prior to the present price depression, expenses other than labour and interest showed a per-unit variation of approximately 20 per cent. for the production range 100–150 lb. of butterfat per acre.

In view of the pertinence of this established fact, the importance of studies into methods calculated to increase unit area production cannot be overestimated. With a dead load of capital debt, plus an elusive factor represented by cash put into farms and known as "farmer's equity," the exploitation of unit area production as a direct method of reducing unit production costs assumes a wider significance than the welfare of individual farmers, as national readjustments and financial stability are directly involved.

It should be recognized that dairying and its natural sideline activities represent the one branch of primary production which offers

great scope for a rapid increase in volume of output. There is no reason why our exportable surplus of butterfat should not be raised by 50 per cent. above its present level in a comparatively short space of time. Even at present price-levels this would represent a tremendous advance in trading power, and the dairy industry therefore has an obligation to the State in view of its potentially strong position. If the present price-level for all primary products is the standard on which the future must be based, then dairying constitutes the major industry which has reasonable chances of meeting a fair proportion of its capital commitments. To do so, however, the seriousness of the position and the responsibility of producers in the State fabric must be fully appreciated, so that governing bodies and farmers may be prepared to co-ordinate dairying activities in a manner calculated to attain a definite objective in as short a space of time as is possible.

In the following discussion an endeavour has been made to present some aspects of farm organization in such a way that dairy-farmers and those interested in the industry may obtain a clearer view of the structure on which the standard of production depends.

Source and Reliability of Data.

The data on which this analysis is based pertain to a total of 967 farm records. The greater portion—namely, 677 farms—are situated in the Middle Waikato Basin and the Bay of Plenty, the production figures applying to the season 1929–30. The remaining 290 instances are from Northern Taranaki.

The source of information was primarily from herd-testing records, farm areas being supplied by farmers themselves, or checked from official records. The reliability of the data is therefore backed by the testing movement. " Cows carried " was taken as that number recorded for the testing period showing the greatest number irrespective of the date. As all cows are tested on testing farms this should be a reliable basis for computing carrying-capacity. The sample of farms was in no way picked, their inclusion depending entirely upon the possession of and facility to check areas. It can therefore be said that sampling depended to a great extent on chance. They can be looked upon as a reasonable average of testing farms for the season 1929–30, but consequently above the average for all farms in the Dominion so far as per-cow and per-acre production are concerned. The 967 farms have an aggregate area of 137,557 acres, and milked 52,385 cows.

For the purposes of analysis farms have been treated under six district headings, each district being, within limits, comparable within itself so far as type is concerned, while there is a wide variation between districts. This variation depends mainly upon the standard of exploitation reached in land utilization, districts having a large percentage of land of an unproductive nature within farm boundaries naturally showing an adverse unit-area production position. It is obvious that the type of farm does not influence management in deciding on the type of cow to be milked. A further factor influencing the range of production between districts is the incidence of cow type within the areas prescribed. It is apparent that in some localities there has not been such a general departure from the foundation stock of the district through importation of replacements.

The question as to whether production should be based on total farm area or only on that area producing milking pastures, is one which presents great difficulties. Undoubtedly the net production area should be taken to obtain a true picture of cause and effect, as the percentage variation in production to total area is very great. An attempt was made to procure a break-up of farm areas, but the results proved that it is not possible to obtain a true production area without incurring considerable expense. As New Zealand farm conditions are being discussed, and as most dairy-farms contain a proportion of unproductive land, it is considered that the number of farms treated is sufficient to reasonably smooth inequalities, and to afford a fair presentation of facts under the average farming conditions to be found in our main dairying districts.

FACTORS INFLUENCING AND CONTROLLING THE STANDARD OF PRODUCTION PER UNIT OF AREA.

In the final analysis, production per unit of area is determined absolutely by (1) area of farm, (2) number of cows milked, and (3) average production of butterfat per cow milked. Production per acre is therefore determined by the equation

$$\frac{\text{Cows milked} \times \text{average butterfat per cow}}{\text{Area of farm}}$$

Once this equation is established for any farm, no other figure can be added to influence the final result. Therefore farm management or organization aiming at an increased unit-area output must aim at influencing the unstable factors comprising the equation. As farm area is not readily adjustable the attack must be on carrying-capacity and cow performance.

It is very apparent that it is desirable and that there is room to effect a change in the big majority of dairy-farms. In Table 1 is presented a most illuminating picture of the average conditions prevailing on farms which are undoubtedly above the average in degree of exploitation. This would suggest that if an average could be taken over

Table 1.—Farms grouped according to Butterfat produced per Acre (Unweighted Averages).

Butterfat per Acre Range.	Number of Farms in Group.	Percentage of Farms in Group.	Average Cows per Farm.	Average Size of Farm.	Average Test.	Average Milk per Cow.	Average Butterfat per Cow.	Average Cows per 100 Acres.	Average Milk per Acre.
lb.				Acres.	Per Cent.	lb.	lb.		lb.
25–50 ..	40	4·14	52	258	4·4	5,053	224	20·8	1,030
50–75 ..	156	16·13	53	201	4·4	5,418	239	27·0	1,452
75–100 ..	208	21·51	53	151	4·5	5,697	255	35·2	1,977
100–125 ..	242	25·03	54	130	4·6	5,926	270	42·1	2,463
125–150 ..	146	15·10	55	112	4·6	6,093	281	49·3	2,976
150–175 ..	94	9·72	54	100	4·7	6,441	303	54·2	3,462
175–200 ..	47	4·86	56	92	4·8	6,444	307	61·2	3,892
200–225 ..	22	2·27	58	86	4·8	6,483	309	69·2	4,439
225–250 ..	8	0·83	79	104	4·9	6,318	311	77·1	4,789
250–275 ..	1	0·10	39	48	4·9	6,732	329	81·2	5,470
300–325 ..	3	0·31	72	83	4·9	7,213	357	86·1	6,225

all farms in New Zealand a much lower scale of production would be presented than found in this table. The percentage of farms falling within low per-acre groups would be materially increased, and would show the real scope for improvement in output to better advantage.

When studying this table it should be remembered that average per-cow production reached a peak in 1929–30, the average for the Dominion in that period being 218 lb. of butterfat. The next highest average yield was that of 211 lb. for the previous season (1928–29). Herd-testing records also show that the season under discussion established a record, figures for all group-tested cows averaging 253·61 lb. butterfat, while the next best season's performance was 241·05 lb. per cow.

It will be noticed that 77·77 per cent. of the total farms fall within the 50–150 lb. butterfat per-acre range, and that farms producing more than 150 lb. per acre are comparatively rare, even in a good season. The average for the 967 farms is in the vicinity of 112 lb. of butterfat per acre, clearly indicating the scope for improvement on low-production farms, and on those grouped round the average.

In the sample taken the size of milking herds does not vary materially, but large farms are directly associated with low-scale production. This is undoubtedly due to less intensification of stock and inferior exploitation of land, a labour and liquid capital scarcity resulting in an unbalance between stock and potential food supply.

The percentage butterfat content of milk as expressed by test shows that animals producing high-test milk are more generally found on high per-acre production farms than the reverse. The range of movement in test under this system of grouping is not great, however, indicating that herds of all types are to be found in any production group. This is substantiated by the movement in average milk yields. The fact that average milk yields vary from approximately 5,400 lb. in the 50–75 lb. per acre group to almost 6,500 lb. in the 200–225 lb. group suggests further that low-test animals, particularly in the low-production groups, have not received the treatment necessary for maximum production, as from a physiological viewpoint low-test cows should on the average produce a greater bulk of milk than high-test animals. The position operating on New Zealand farms as disclosed by this analysis automatically ensures that, when an increasing test is combined with an increasing milk-yield, the resultant per-cow production rises with increased per-acre output at a rate which is sharper than should actually be the case if all animals were fed in a manner calculated to fully exploit their production capabilities.

The most potent factor influencing per-acre production is the number of cows milked per unit of acre farmed. The data under discussion reveal an extremely wide range of variation, amounting to well over 100 per cent. It has been mathematically established from a detailed study of the 144 Bay of Plenty farms included in this analysis that the movement in per-acre production is influenced by carrying-capacity and per-cow production in the ratio of two to one.

This analysis substantiates the contention which so often has been made—namely, that the first line of attack in an endeavour to increase unit-area output should be an increased carrying-capacity of milking

cows. If this can be achieved coincident with an improved milking strain of animals, then the movement in output is materially accelerated.

The yield of milk per acre naturally moves in accordance with the other features which go to make up the range of per-acre production.

Farmers' Control over Production Standard.

The farmers' immediate control over the per-acre unit standard of butterfat production is determined through internal organization and food supply. Once these factors have been fixed the influence of animal type as exemplified by body structure and milk test is beyond his immediate jurisdiction. Therefore factors determining the production level can be divided into three categories: (1) Organization; (2) management; (3) animal type. The third feature is inseparable from the first, and is controlled by the farmer in deciding his stock organization. The decision is, however, often made without due consideration being given to its influence on production, and therefore demands separate treatment.

Organization is directly concerned with stock and with the internal arrangement of the farm itself, but particularly with stock so far as it pertains to this discussion. The type of animal chosen determines within narrow limits the percentage butterfat content of milk produced. Their potential production-capacity is determined by the strain of producers included in the herd and the sire put at its head. Once these arrangements are made, the final volume of output is controlled by management, with an unknown quantity known as climatic conditions influencing the results. The fact that climatic conditions can so materially affect output only substantiates the contention that management efficiency can also account for a wide range of exploitation of strain potentialities, as management can to some extent flatten out the ill effects of adverse climate.

The flexibility of cow performance has been admirably demonstrated during the past three seasons. The Dominion average for all cows in milk or dry rose to a peak of over 218 lb. in the season 1929–30. In the following season it dropped to 201 lb., and for the present season (1931–32) the average will be in the vicinity of 185–190 lb. This drop is due to climatic conditions, aggravated by a most unfortunate set of circumstances resulting in a diminution of fertilizer usage to the extent of 130,000 tons below requirements based on the quantity used for the production season 1929–30. This has undoubtedly restricted management, particularly in the conversion of surplus pasturage into food reserve, to say nothing of the depletion of plant-food reserves in the soil itself.

It cannot be accepted that the general level of stock potentiality has dropped, even though herd-testing figures show a reduction in the percentage of cows tested registering above 250 lb. We therefore come back to the fact that when stock organization is fixed and climatic conditions are constant the level of per-acre production is determined by efficiency in management, whether it tends toward an increased density of milking cows or to exploitation of the capabilities of the herd. Maximum exploitation under fixed stock conditions is therefore a question of quantity and quality of food supply, and affects unit-area production through the ability to milk more cows and to improve

individual cow performance. It is not suggested that the range of carrying-capacity and average yield as illustrated in the 967 farms analysed is due entirely to a similar range in management efficiency. It is nevertheless true that farms falling within any group within the range have a wide margin of variability, and can be raised or lowered in the scale by varying farm management.

CARRYING-CAPACITY.

The average conditions accompanying a range of carrying-capacities and herd averages can now be studied in some detail. As previously stated the term carrying-capacity is used to denote the total number of cows milked on individual farms at any time during the season. If a complete balance is maintained, carrying-capacity is determined by the volume and quality of food produced combined with the consumption requirements of dairy cows. Their consumption needs are determined by their potential productive capacity plus the amount required to maintain body weight. Thus, with a fixed food provision, the ratio between body weight and productive capacity per unit of weight should be as wide as possible.

How are these features balanced under average farm conditions, and what is the effect of the degree of efficiency prevailing on the ultimate measure of production efficiency? Table 2 affords data along these lines for the farms under review.

Table 2.—Farms grouped according to Carrying-capacity per 100 Acres (Unweighted Averages).

Cows Milked per 100 Acres Range.	Number of Farms in Groups.	Percentage of Farms in Groups.	Average Number of Cows in Herds.	Average Size of Farms.	Average Butter-fat per Cow.	Average Milk per Cow.	Average Test.	Average Butter-fat per Acre.	Average Milk per Acre.
				Acres.	lb.	lb.	Per Cent.	lb.	lb.
Under 30..	197	20·37	50	208	257	5,668	4·5	63·1	1,391
30–40 ..	260	26·89	54	153	263	5,848	4·5	93·2	2,080
40–50 ..	275	28·44	55	123	271	5,926	4·6	120·8	2,629
50–60 ..	155	16·03	56	104	278	6,082	4·6	151·4	3,302
60–70 ..	52	5·38	60	92	283	5,965	4·7	180·5	3,825
70–80 ..	18	1·86	60	81	268	5,789	4·6	197·6	4,275
80–90 ..	8	0·83	51	62	295	6,228	4·7	245·0	5,180
90–100 ..	1	0·10	90	100	356	7,225	4·9	320·4	6,503
100–110 ..	1	0·10	102	100	227	4,652	4·9	231·3	4,745

NOTE.—The last three groups can be ignored owing to small numbers.

It will be seen that the average carrying-capacity for all farms under review is comparatively low, amounting as it does to 41·6 cows per 100 acres. If this set of farms is accepted as a fair sample of the better-class farm and management, it is apparent that instances of very high carrying-capacities so often heard of are remarkably rare when all the facts are studied.

The size of herds does not materially affect carrying-capacity, although the number of cows in herds of greatest density tends to increase. The size of farms in relationship to cow density, however, is very marked.

The range of variation in milk and test, and consequently in butterfat per cow, is very narrow, particularly for those groups below eighty cows

per 100 acres. The significance of this fact is that all types and strains of cows are to be found in herds of varying intensity, with the suggestion that low-test herds are more likely to be found in the lower carrying-capacity groups. The direct relationship between cow density and production of butterfat and milk per unit of area is very marked, as when arranged in this way it is evident that these two results are mainly determined by the number of effective milking cows carried on a given area.

PRODUCTION PER COW.

The productive quality of a herd is determined by the inherent productive ability of its individual units. Its potential capacity is never fully exploited under average farm conditions, as the quantity and quality of the food supply can never be perfectly balanced with the complete requirements of the herd. It is a well-known fact that individual animals receiving special treatment when entered for the C.O.R. test will produce much higher than under average herd conditions. Herd averages may also be detrimentally affected by undue exploitation of carrying-capacity. Thus it is possible for any herd to vary its position in the production range from season to season, the movement being in either direction according to treatment and conditions despite its inherent capacity to produce. Herd average is undoubtedly the most unstable factor controlling the standard of unit-area production.

The conditions surrounding and facts resultant from the variation in herd averages as found in the farms under review will be seen in the following table :—

Table 3.—Farms grouped according to Herd Average of Butterfat per Cow (Unweighted Averages).

Herd Average Butterfat per Cow Range.	Number of Farms.	Per-centage of Farms.	Average Number of Cows.	Average Size of Farm.	Average Test.	Average Milk per Cow.	Average Number of Cows per 100 Acres.	Average Butterfat per Acre.	Average Milk per Acre.
lb.				Acres.	Per Cent.	lb.		lb.	lb.
150–175 ..	6	0·62	46	129	4·4	3,795	39·6	64·8	1,508
175–200 ..	44	4·55	59	181	4·3	4,441	35·6	67·2	1,614
200–225 ..	84	8·69	58	163	4·4	4,884	37·8	80·9	1,842
225–250 ..	198	20·47	58	158	4·4	5,465	39·9	95·1	2,185
250–275 ..	223	23·07	52	138	4·5	5,794	41·5	108·4	2,398
275–300 ..	196	20·27	53	132	4·7	6,174	43·4	124·4	2,662
300–325 ..	121	12·51	52	130	4·7	6,656	44·0	136·6	2,919
325–350 ..	68	7·03	50	122	4·9	6,849	43·7	146·7	2,908
350–375 ..	23	2·38	52	114	4·9	7,372	48·5	175·7	3,585
375–400 ..	3	0·31	45	98	4·8	8,174	45·9	177·9	3,752
400–425 ..	1	0·10	67	160	5·3	7,810	41·9	168·6	3,270

The average per-cow production over the 967 herds, as discussed above, amounted to 268 lb. of butterfat. The average for all cows in the Dominion was 218 lb. for the season 1929–30, and if the modal group were moved back to the 200–225 lb. position, as it would be if all farms could be included in the analysis, the percentage distribution would be materially affected.

The size of herd is comparatively stable throughout, and the size of farm is not such an important factor in association with herd averages as with cow density. There is, nevertheless, a trend toward a decrease in area as per-cow production increases, but it appears that all grades of herd averages may be found on farms of any particular area.

The movement in milk-test and milk produced per cow indicates again that under average farm conditions in New Zealand the type of cow giving a high milk-test has an advantage over those of low test. Although the comparative flatness of test range shows that all types of animals are to be found in any cow production group, high-testing herds are more numerous in the higher ranges of per-cow output.

The standard of per-cow production is controlled by test and milk yields. The fact that low-test animals have greater milk-secretion capabilities stresses the point that a proportion of such herds are included in the high productive groups. If these herds had been fully exploited they should have been more generally included in the higher ranges, which would have resulted in a still flatter range of test. It would also have exerted a similar influence on carrying-capacity, and on yield per acre.

Under the conditions prevailing, however, it is found that herds with high averages are associated with increased carrying-capacity, the combination of which result in rapid movement of unit-area production both of butterfat and milk.

Cow Type and its Influence on the Production Standard.

In the foregoing discussion factors of organization and management have been reviewed, which are subject to variation under a range of management and climatic conditions. It has been necessary to treat them in some detail to show that herds of any type (as signified by milk-test) are, under average farm conditions, found throughout the whole range of herd averages, cow densities, and unit-area production. The discussion up to this point has aimed to show that the method of random sampling adopted has not put any herd-type in an unfair position so far as type of farm and standard of land exploitation are concerned. If any herd-type is penalized through unproductive area it is that having a high milk-test, as a study of the individual farms shows that those having a high percentage of non-exploited land are slightly more prevalent in those groups where test is comparatively high. The same farm data can therefore be used to show quite impartially the economic position of production based on variation in the percentage butterfat content of milk. The test range for the farms under discussion is from 3·5 to 5·4 per cent., and therefore covers all types of cows within reasonable limits. Under herd-testing conditions, the average test for the 967 farms is 4·57 per cent. When this is realized, and the distribution of farms within the test groups as shown in Table 4 is studied, it will be appreciated that advocacy of the production advantages accompanying high test is not a revolutionary suggestion, but merely a substantiation of this policy being adopted by the majority of farmers in ordinary management.

The percentage distribution of these farms within the test range suggests that members of herd-testing associations—in the North Island

Table 4.—Farms grouped according to Average Test of Butterfat Content of Milk (Unweighted Averages).

Milk Test Range.	Number of Farms.	Percentage of Farms in Groups.	Average Number of Cows.	Average Size of Farms.	Average Test.	Average Butter-fat per Cow.	Average Milk per Cow.	Average Cows per 100 Acres.	Average Butter-fat per Acre.	Average Milk per Acre.
Per Cent.				Acres.	Per Cent	lb.	lb.		lb.	lb.
3·5–3·8 ..	50	5·17	57	170	3·69	240	6,472	36·7	88·0	2,382
3·9–4·2 ..	155	16·03	59	162	4·09	247	6,033	39·1	96·9	2,366
4·3–4·6 ..	333	34·44	53	139	4·47	260	5,816	41·3	108·4	2,417
4·7–5·0 ..	332	34·33	52	135	4·83	280	5,809	43·3	122·1	2,540
5·1–5·4 ..	97	10·03	54	133	5·21	302	5,791	43·2	131·3	2,514

at least—are knowingly or unknowingly raising the average test of their herds. The average test for all milk delivered at cheese-factories is in the vicinity of 4·1 per cent., but unfortunately a similar figure for the whole factory supply is not procurable under home separation for butter-factories. It is probable, however, that if the figure were procurable it would be found that the average for all herds would be higher than that registered in cheese-factories alone.

When herds or farms are grouped in this way the milk-production capacity of low-test herds becomes apparent, even under average farm conditions. The range of variation registered is not great, however, the increased butterfat content of the reduced bulk of milk still giving a material advantage in average butterfat production per herd. This, combined with a greater density of milking cows on farms running high-test herds, results in a wide variation in unit-area production of butterfat over the range of test groups. This increase in butterfat production is accompanied by a slightly increased output of milk per acre also. The flattening tendency shown in carrying-capacity and yield per acre for the last group is due to an unusual proportion of unproductive land on some of the farms, which penalizes the group unduly in comparison with those of lower average test. Carrying-capacity should have been in the vicinity of 46 cows per 100 acres.

It has been mentioned previously that test (and its accompanying conditions) is the most stable factor influencing the standard of butterfat output, as it cannot be affected to any marked degree by ordinary management variation on commercial dairy-farms. (There is another factor which is to a great extent associated with test—namely, body weight—but this has been excluded owing to lack of detailed information. Its importance will be discussed at a later stage.)

It is a well-known fact that herd-test does vary from day to day, the chief causes of variation being of a physiological nature. Excellent examples of this daily variation are to be found in Veale's records of three Taranaki herds studied during the season 1926–27, to establish a comparison between high- and low-test milks for cheesemaking. This does not, however, detract from the statement that test is the factor most removed from the influence of the farmer in his ordinary course of management. In view of this fact, and having established the close correlation of test with yields of butterfat and milk, both on a per-cow

and per-acre basis, the question arises as to whether it is not economically sound to urge an acceleration in the direction of organization of herds to ensure a higher average test than is found to prevail at the present time.

STANDARDS FOR CONVERSION OF THE RAW MATERIAL.

To obtain a clearer perspective of the position, it is necessary to interpret the production figures disclosed in Table 4 in such a way that the gross value represented may be readily appreciated. Before proceeding to convert butterfat and milk to a butter or cheese basis it is necessary to discuss the conversion figures which may be used.

The conversion of butterfat to butter presents no difficulties, as only one factor has to be dealt with. Conversion of butterfat or milk to cheese is a different problem. It is not necessary to go into the question of cheese yields in relation to the varying chemical composition of milks, or to the extent to which yield depends on moisture content of the finished product. The difficulty arises in adopting any standard which may be acceptable to all parties, thus obviating any charge of partisanship. It is a well-known fact that when low-test milk is used for cheesemaking a greater weight of cheese is made per pound of butterfat contained in the milk than is the case with an equal amount of butterfat contained in milk of high test. It is not so well known and generally recognized that more cheese is made from 100 lb. of milk of a high test than is the case with a similar weight of milk of low test. Either the production of cheese per pound of butterfat or the production of cheese per 100 lb. of milk may be used as a conversion standard, provided the standard used is derived directly from the relationship of one or the other to the range of test subscribed.

The standard table which is perhaps best known and most extensively used in America is that given by L. L. Van Slyke. This standard is based on cheese weights corrected to a uniform moisture content, and as under New Zealand factory conditions cheese made from low-test milk contains a greater percentage of moisture than does that made from high-test material, the Van Slyke standards are not strictly comparable.

In the *Monthly Abstract of Statistics* for July, 1928, the Government Statistician published a table showing the weighted average production of cheese per 100 lb. of milk for all cheese-factories in New Zealand for the season 1926–27. The smoothed average for all factories does conform very closely to the Van Slyke standards, but it is apparent from the district variations shown that undue weight is given to peculiarities appearing in certain localities, particularly to low yields obtained in Otago-Southland and high yields in Taranaki. The range of yields given for the rest of the Dominion does, however, provide a reasonable basis of calculation. Two other sources of New Zealand data have been made available through the courtesy of Professor Riddet, Director of the Dairy Research Institute (N.Z.), and Mr. P. O. Veale, Research Chemist, Federation of Taranaki Co-operative Dairy Factories. The figures established by Veale in his investigations in 1926–27, and those from Massey Agricultural College for the season 1930–31, combined with figures for all Dominion factories (less those of Taranaki and Otago-Southland for the season 1926–27), provide a

basis for the establishment of a New Zealand standard which appears the most satisfactory available. It is most desirable, however, that further research be carried out for the final acceptance of a standard conforming to an average for all New Zealand factories.

The average of the three sets of figures mentioned above provides a standard of conversion which conforms to that quoted and used by Professor J. L. Sammis, of Wisconsin University, and for the purposes of this article the standard used by him will be taken as typical of the average factory. The standard quoted by Sammis is as follows :—

Table 5.—Cheese per 100 lb. of Milk and per Pound of Butterfat

Percentage of Butterfat in Milks (Test).	Cheese per 100 lb. of Milk.	Cheese per Pound of Butterfat.	Percentage of Butterfat in Milks (Test).	Cheese per 100 lb. of Milk.	Cheese per Pound of Butterfat.
Per Cent.	lb.	lb.	Per Cent.	lb.	lb.
3·5	9·740	2·783	4·4.. ..	11·288	2·565
3·6	9·912	2·753	4·5.. ..	11·460	2·547
3·7	10·084	2·725	4·6.. ..	11·632	2·529
3·8	10·256	2·699	4·7.. ..	11·804	2·511
3·9	10·428	2·674	4·8.. ..	11·976	2·495
4·0	10·600	2·650	4·9.. ..	12·148	2·479
4·1	10·772	2·627	5·0.. ..	12·320	2·464
4·2	10·944	2·605	5·1.. ..	12·492	2·449
4·3	11·116	2·585	5·2.. ..	12·664	2·435

UNIT-AREA PRODUCTION IN TERMS OF MONEY AND TRADING POWER.

It is now possible to convert the unit-area production figures as shown in Table 4 into the equivalent of butter or cheese, and to interpret production in terms of money represented to the farmer, and in volume of output as it affects the trading power of the Dominion.

Table 6.—Farms grouped according to Butterfat Content of Milk (Test), showing Butter or Cheese Equivalent per Unit of Area (Unweighted Averages).

Percentage of Butterfat in Milk (Test) Range.	Butter per Acre.	Cheese per Acre.	Pay-out per Acre based on Butterfat at 11d. per Pound.	Percentage of Total Farms represented.
	lb.	lb.	£ s. d.	
3·5–3·8 ..	106	240	4 0 8	5·17
3·9–4·2 ..	117	254	4 8 10	16·03
4·3–4·6 ..	131	276	4 19 4	34·44
4·7–5·0 ..	148	305	5 11 11	34·33
5·1–5·4 ..	159	319	6 0 4	10·03

The approximate position as disclosed in this tabulation is that for every 0·4 per cent. increase in butterfat content of milk the farmer receives an additional pay-out of 10s. per acre. This is equal to about a 12 per cent. increase in the lower scale of test for each such movement, diminishing to 10 per cent. as per-acre pay-out increases in sympathy with the rise in butterfat content of milk. If all herds had fallen in the 5·1–5·4 per cent. test group, and a corresponding production standard had been realized, the average pay-out per acre over all farms would have been over 17 per cent. above that actually realized. An

average improvement of this dimension naturally means a far greater increase in income from those farms in the low-test groups, the extreme range being over 50 per cent. in the case of individual farms.

The position as discussed shows the advantage to be derived by raising the test over a group of herds averaging 4·57 per cent. to a uniform level of 5·21 per cent. of butterfat in the milk. As previously mentioned, the test generally accepted as the average for all herds in the Dominion is about 4·1 per cent., which corresponds with a production of 97 lb. of butterfat per acre. If this is the true average position, then the raising of the general level to an extreme point of 5·21 per cent. would result in an increased output of over 35 per cent. of butterfat. This would represent a corresponding addition to the total pay-out of farmers at any price-level, and also in trading power to the State. It is necessary to keep this point in mind during this and subsequent discussions.

This increase in per-acre receipts can be also interpreted as volume output of butterfat, and it is in this connection that the national aspect assumes great importance. It is contended that the sample of farms treated in this analysis is of sufficient size and variety in type to allow of the assertion that the movement in per-acre production shown in Table 4 is due practically wholly to variation in test and the conditions accompanying this variation. It can therefore be said that by an adjustment of organization in the direction of herds of high average test, the volume of butterfat output could be increased by at least 17 per cent., but probably as much as 35 per cent., without any material alteration in the standard of general farm and herd management. The total estimated weight of butterfat produced in the season 1930–31 was 322,000,000 lb. Assuming an increase of only 17 per cent. on this total, the increased output would represent over 54,000,000 lb., all of which would be available for export, as such a readjustment would not entail a greater internal usage of whole milk or milk products. This would equal a 22 per cent. increase on butterfat at present exported in the form of butter and cheese. The question as to the form in which any such increase should be exported need not be discussed at the present time, but it is apparent that our trading power must be considerably enhanced by an increase in output as mentioned above.

TEST AND ITS RELATION TO CHEESE.

Any concerted action aiming at the immediate improvement in the financial position of farmers through raising the test may be met by the argument that high-test milk is not so suitable for cheese manufacture. It is not intended to enter into a discussion of the technical points of manufacture involved, but it is desirable to mention that Veale's experiments of 1926–27 showed that the average quality of the products of high- and low-test milk was equal. They all had defects or virtues at different times of the season, but, on the whole, high-test milk supplied a cheese which, if anything, received a higher average valuation in London than did that from low-test varieties. This being the case, the economics of test variation come back to the farm itself.

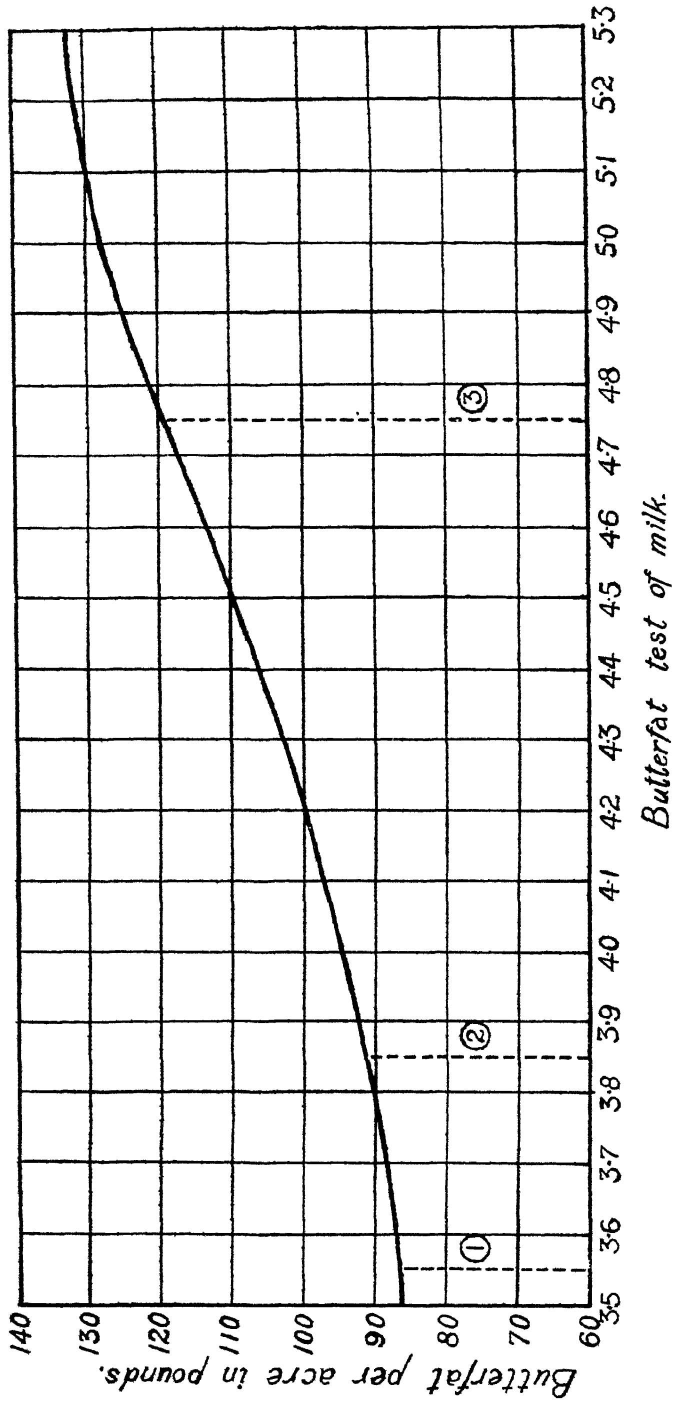
The relationship of test to high unit-area output clearly illustrates the advantages to be obtained by the exploitation of a high-test herd, irrespective of the nature of the factory supplied. It has been argued

that pay-out on a butterfat basis at a cheese-factory penalizes the owner of low-test herds, owing to the greater amount of cheese per pound of butterfat obtained from low-test milk. It is claimed that a differential payment should therefore be made in accordance with the variation in cheese yield of milks with different fat contents. Veale, in Bulletin No. 9, N.Z. Department of Scientific and Industrial Research, when dealing with this question, states that the value for cheesemaking of milks testing 3·55, 3·85, and 4·75 per cent., should be 17·687d., 16·548d., and 15·335d. per pound of butterfat respectively for the season concerned. These pay-out values are based on the products from three herds having average tests as quoted above. For our present purpose these values can be accepted without going into the variations in manufacturing costs which are undoubtedly associated with the handling of greater weights of low-test milk required to produce a given quantity of cheese.

In Veale's discussion all milks were debited with a flat charge of 3·75d. per pound of butterfat to cover costs of manufacture and charges up to f.o.b. It is probable that investigation would reveal that the variation in costs in this and other directions for different test milks would to some extent offset the difference in yield on a fat basis. Accepting these values in the meantime, it is illuminating to plot the three herd-records used by Veale, against the production curve for the 967 herds embodied in the present analysis. This is done in the accompanying graph. It will be seen that the production curve is based on per-acre output for different test groups as found in Table 4. The point at which Veale's three herds strike the production curve is determined by the projection of a straight line from the base-line of test range, at that point which corresponds with the average for the respective herds dealt with. It is not suggested that the actual per-acre production for these three farms was exactly the figure indicated by this method. It is contended, however, that the herds embraced in this production curve are sufficiently representative of their test group to ensure that herds of any particular test are likely to give on the average a per-acre output corresponding with the curve shown within a reasonable margin of error. On this assumption it will be found that Farm 1, with an average herd-test of 3·55 per cent., coincides with a per-acre production of 86 lb.; Farm 2, with an average herd-test of 3·85 per cent., 91 lb.; and Farm 3, with an average herd-test of 4·75 per cent., 119·5 lb. per acre. If the values of these productions are computed at the prices previously discussed and assessed by Veale, it will be found that the respective per-acre returns are as follows:—

Table 7.—Probable Average per-Acre Production of Farms with Tests as used by Veale, and Pay-out on his Butterfat Valuation.

Average Herd-test.	Estimated per-Acre Production.	Total Pay-out per Acre at 17·687d. per Pound.	Total Pay-out per Acre at 16·548d. per Pound.	Total Pay-out per Acre at 15·335d. per Pound.	Index of Pay-out.
Per Cent.	lb.	£ s. d.	£ s. d.	£ s. d.	
3·55 ..	86·0	6 6 9	..	..	100
3·85 ..	91·0	..	6 5 6	..	99
4·75 ..	119·5	..	..	7 12 9	121



GRAPH SHOWING CORRELATION OF BUTTERFAT PRODUCTION PER ACRE WITH VARIATION IN MILK TEST.

The vertical dotted lines, numbered 1, 2, and 3 respectively, represent the three herds referred to in the text (see preceding page).

To obviate any misconception on the part of individual farmers, it must be reiterated that the production position for herds of different tests, as indicated above, may not coincide with the per-acre production standard of single farms carrying herds conforming to such test standards. It is contended, however, that if groups of farms carrying such herds are studied as groups, the law of averages will ensure that average unit-area production for any group will conform closely to the standard production curve given, which is based on test variation. Although individual farms are treated in this instance, they are examples only, and should not be looked upon as individual units, but rather as representative of the average of all farms carrying herds of the type giving the milk-test prescribed. If this precaution is observed it will be seen that, even on a reduced pay-out for butterfat contained in high-test milk, the respective farmer's position is likely to vary by 21 per cent. on an average run of farms carrying herds conforming to this range of test, the advantage still being in favour of those farms milking a herd and supplying milk with a high butterfat content.

What is the practical application of the facts under discussion with reference to milk test? It has been proved beyond question that under average farm conditions, where farm type and management are as nearly equal as it is possible to arrange them, test variation and the conditions accompanying such variation are responsible for a very decided increase in output of butterfat per unit of area farmed.

The financial return to farmers supplying factories is in direct proportion to the per-acre increase obtained in butterfat production, when pay-out is based on butterfat supplied. This must always be so in the case of suppliers of butter-factories, and before any alteration can be made in the case of milk for cheesemaking it is apparent that very thorough investigation must be made to substantiate the need for and fairness of any differential payment for high- or low-test milk. The problem in relation to cheese-factory supply has two distinct aspects—namely, the economics of butterfat production on the farm and the economics of manufacturing and marketing of the finished product. This work has never been done comprehensively, and undoubtedly should be carried out under strictly controlled conditions and over a long enough period, so that the advantages and disadvantages of a mixed supply of milk of different tests may be finally established. Enough has been said, however, to show that when the financial position is studied on a pay-out basis which forms the most adverse comparative data available for milks of different tests, high-test herds will on the average give the farmer a better per-acre return, no matter what type of factory is supplied. The other fact, which cannot be too strongly stressed, is the effect of increase in unit-area production on farm production costs per unit of output.

As has been suggested previously, organization and management of the dairy-farms of New Zealand has been consciously or unconsciously moving in the direction of the building-up of herds calculated to give milk of higher test. From the viewpoint of economy in production and total volume of the Dominion's output this movement is undoubtedly sound. The pursuance of such a policy will raise problems to be overcome in the conversion of high-test milk into cheese, but it seems apparent that the advantages to be gained from increased output

are such that it is factory technique which must be altered to suit the supply rather than the supply altered to suit existing technique.

MARKETING QUESTIONS.

The total volume of butterfat produced in the Dominion during the season 1930 – 31 slightly exceeded 322,000,000 lb. Of this total 211,500,000 lb. was represented by butter manufactured, and 75,500,000 lb. by cheese. Although cheese does not approach butter in the amount of butterfat used in its manufacture, it is essential that the volume of cheese should be at least maintained. This becomes very apparent when it is remembered that New Zealand holds the key position in the import cheese markets of Britain, being responsible for approximately 60 per cent. of the total imports. The position we occupy in the supply of cheese is relatively much stronger than for butter, and it is imperative that this be maintained. The tendency is for surplus butterfat from all exporting countries to be exported to Great Britain in the form of butter. The relative strength of the market for butter and cheese reflects this to some extent, in so far as the price ratio between the two commodities is in favour of cheese and has been for some time past. The 15 per cent. of Britain's imported cheese supply which is derived from countries other than Canada and New Zealand is mainly of foreign origin. It is difficult to foresee what may happen to this supply under altered tariff conditions, but, whatever the movement may be, New Zealand should gain if she is in a position to make up any deficiency in supply occasioned through Britain's preference policy. The level of cheese consumption is comparatively stable in Great Britain, but it appears that consumption of butter can be stimulated by the supply of high-grade produce at attractive prices.

Unless the spending power of those classes of the British consumer on whom we depend is materially increased, the whole of our efforts should therefore be towards an increased supply of produce at a price which ensures maximum and rapid consumption, rather than an effort to raise prices under artificial conditions. Although the butter consumptive capacity of Great Britain has proved extremely elastic, the rate of increase registered of recent years cannot be expected to continue, particularly at higher prices. It seems that increased absorption must take place through displacement of other products. If this is materially true, then the object of our farm organization and management must be towards the production of butterfat at a lower price for some years to come, which will necessitate reorganization of existing conditions to allow of a balance between production costs and realized prices.

FULL EXPLOITATION OF DAIRY HERDS.

To facilitate such a position it is necessary that immediate plans be made to produce more stock food of improved quality. Coincident with the execution of such a plan, a breeding replacement policy should be pursued which will ensure that replacement stock is of a type calculated to raise herd averages, and at the same time allow of the widest possible ratio between the percentage of food consumed to maintain body condition and that which is converted directly into milk. In other words,

replacement stock should be kept strictly from cows producing above the herd average. In addition, replacement stock should be the progeny of animals so selected that the average herd-test will be raised and a maximum density of cows carried per unit of area farmed.

To allow of such a policy being exploited to its fullest extent it is essential that all dairy cows in the Dominion (at least those supplying dairy factories) should be tested annually. The degree of accuracy desired should be such that reasonably sound methods may be used in breeding and culling. Before such a scheme can be put fully into operation it is necessary that methods of testing be investigated which will give a reasonable degree of accuracy at a low cost. In anticipation of such a movement, and to facilitate the further study of the effect of stock types on unit-area production, it is imperative that all herd-testing records should include milk yields and test data, and that the total area of the farm and other land devoted to the dairy herd should be recorded.

To carry the investigation to a further stage it is necessary that research be conducted to determine the relationship of body weight to food consumption, milk yield, and average milk-test. This research would include measurements of static physical features, with the object of arriving at a method of determining body weight through one or two static conversion factors. Once this point has been reached, potential production under average farm conditions could be assessed with a reasonable degree of accuracy by a very limited number of testing periods.

In utilizing any such data for the culling and replacement programme due regard would be given to the correlation of body weight to carrying-capacity. It is apparent at the present time that light young heifers may be culled on butterfat records in favour of heavier animals, whereas if production per unit of body weight were taken into consideration the decision would be reversed.

These are points which may not appear very important to individual farmers, but when considered in the light of a far-reaching Dominion plan for the full exploitation of dairy herds and the land on which those herds graze, the aggregate advantages to be gained will be great.

SUMMARY.

The position, so far as this analysis has been carried, may be summed up as follows:—

(1) Butterfat production per unit of area farmed is the final measurement of farm and herd organization and of efficiency in production management.

(2) When herd organization has been decided upon, butterfat production per unit of area and per cow can be varied over a wide range despite the potential capacity of the herd. This can be brought about by alterations in farm organization, and by the quantity and quality of food resulting from pasture management—always accepting that climatic conditions may modify the effects of such management.

(3) The percentage of butterfat contained in milk (milk test), and the amount of milk produced, are additional factors to be considered in herd organization. The effects of milk test and the conditions surrounding it have never previously been taken into consideration

in studying variations in unit-area production. It is apparent, however, that the economics of production are materially affected by such conditions, and as test variation from a static herd is virtually beyond the control of farm management, the test point at which a farmer is aiming should be carefully considered, and herd organization deliberately planned to bring about the desired results in as short a space of time as is possible.

(4) The most important factor influencing variation in unit-area production is cow density, or the number of cows milked per given area. As this is directly under the control of farm management once the herd type is fixed, it should be the first line of attack of all farmers in their efforts to increase output.

(5) The next most easily influenced factor is that of the butterfat average of the herd. Apart from the effect of food supply the potentiality of the herd is influenced each season by the standard of replacement of stock entering their lactation life. Therefore culling should be done on proved facts, and replacements made by heifers from proved cows. To ensure that even then the programme is a sound one, the potentiality of the herd sire and his ability to throw heifers of a production capacity above that of the dam should be firmly established.

(6) The two preceding features of herd and farm management are clearly understood and accepted by most farmers. The effect of test may not be so readily accepted, as alteration in cow types raises problems of assumption and sentiment. Its importance cannot be too strongly stressed, and wherever practicable should be fully considered. It is apparent that cow density and herd averages are influenced by body weight, by the standard of milk production, and by butterfat content of milk, and that these latter points must be taken into account when determining the efficiency of organization and management.

(7) The question of increased unit-area production, and consequently the total butterfat output of New Zealand, assumes a degree of importance under present conditions which warrants very drastic measures to ensure that the greatest possible benefits shall be derived by individual farmers, and that the trading power of the State is enhanced to the extent which it has a right to expect from the farms of the Dominion.

Acknowledgment is made of the co-operation of Mr. W. N. Paton. Farm Economics Section, in the preparation of this article. It is proposed to publish shortly a further article, dealing with relevant statistical correlations, by Mr. Paton.

Lambs fattened on Linseed.—The Instructor in Agriculture for Hawke's Bay reported that last season a Fernhill farmer had a few bushels of linseed on hand, and sowed this with his rape. The rape was poor owing to the dry season, and when ready to feed off he turned on 600 lambs. For the first ten days they did not touch the rape but fed off the linseed and did remarkably well. When the linseed was finished they only then reluctantly took to the rape. At the end of ten days this farmer sent 304 lambs away fat; the remainder took about fourteen days more to reach condition on rape.

NEW ZEALAND PASTURE SEEDS.

WHAT THE DOMINION HAS TO OFFER.

E. BRUCE LEVY, Agrostologist, Plant Research Station, Department of Agriculture, Palmerston North.

Introduction.

ECONOMIC development of the Empire calls for specialization and exploitation to the fullest of all natural resources at its members' disposal. New Zealand's speciality is grass, and its great natural resource is climate. Roundly, 94 per cent. of the exportable products from New Zealand are derived from grassland. All-the-year grazing, supplemented by hay and silage derived from pasture, are the arresting features of New Zealand grass-farming.

Seed-production as a phase in grassland farming is essentially sound. In a land dominantly grass, periods of high production (spring) alternate with periods of low production (winter). Whereas under stocking conditions alone that balance between winter production and spring production is difficult to secure, and can only be balanced and levelled up by the preservation of certain spring and early summer growth, as hay or silage, or by the growing of special supplementary crops such as roots, the production of seed—which means closing up certain portions of the farms during the peak period of growth—aids materially in stocking the farm so that less disparity exists between the low winter-carrying period and the high spring-carrying period.

Specialization means an ever-improving quality in the article produced. Any serious attempt to improve the productive, lasting, or disease-resistant qualities of the more important pasture plants calls in the end stages for an organization that will see to the production and perpetuation on a commercial basis of those proven types that are the outcome of natural selection or intensive breeding. Any breeding-work in pasture plants, any effort to improve species production, type-persistency, &c., is from the economic aspect doomed to failure without some system of seed certification.

Seed-production from the old-established permanent grasslands is now well in hand in New Zealand under a Government certification plan whereby the strain of seeds produced is of a guaranteed permanent-pasture type.

STRAIN IN PASTURE PLANTS.

The significance of strain in pasture plants is rapidly becoming recognized throughout the world, and it is not overmuch to prophesy that within a few years the pasture-seed trade of the world will be based on pedigree and type. A few words on strain development will serve to show the significance of strain and pedigree in pasture plants. The evolution of species in response to, and their perpetuation in harmony with, the forces of the habitat or growing-place has general acceptation. Hybridization, mutations, &c., have doubtless played a part in the initiation of change in a species, but after such change has been initiated the forces at work in the habitat will decide whether that change will become effective or not. Man in his agriculture throughout the world

has taken up the wild species at a certain point in their evolution, and has applied them in a variety of ways. New habitats have been created, and just as species evolved in response to the call of the habitat under wild conditions, so to-day we can recognize strain in species evolved to suit altered habitats under cultivation. The more widely and variously used the species, the greater the significance attachable to strain within those species.

Perennial rye-grass, cocksfoot, white clover, and red clover, for example, are widely exploited in grasslands in virtually all parts of the world. Each district and each country, according to soil and climate, have used these species in roughly four different ways: (1) For truly permanent pasture that remains down for a long period of years; (2) for short-rotation pastures that are ploughed every two to four years; (3) for strictly temporary pastures that last only one to two years; and (4) for seed-production purposes under any one of these categories.

From our researches up to the present one may say that different strains of herbage plants have developed according to the farming system practised. The old permanent pastures hold, with certain exceptions, to the permanent strain. The short rotation areas have evolved a short-lived type; the arable and annual cropping areas have run distinctly to an annual type. Crops grown specifically for seed have evolved towards stemmy, high seed-yielding types. The cold-winter countries have produced winter-dormant forms. Periodic droughts have produced scant herbage, stemmy, quick-maturing, short-lived forms, and the mild-winter countries have produced winter-growing forms. The permanently grassed, high-production soil-types have produced high-production forms, and the low-production, permanently grassed soils have produced low-production types.

Strains of herbage plants cannot be evolved at a moment's notice, nor yet by years of careful breeding in the nursery under non-pasture conditions. Time is an essential factor during which are brought to bear habitat forces that mould and ultimately fix definite and specific characters. Such characteristics hold to a type until such time as further new habitat forces gradually modify and evolve a type more perfectly attuned to the new environment. Just as the first process involves time as an agent, so modification of an evolved definite type requires time. For example, mother-seed rye-grass of the Hawke's Bay type taken to Canterbury, Australia, or England will remain true to type for many years, and the progeny of that rye-grass would be true to type until such a time had elapsed that the new environment in Canterbury, Australia, or England had made itself felt. Leaving out of consideration the factor of cross-pollination by Italian rye-grass or false perennial forms, it is hard to imagine much change in the type within, say, ten to twenty years, provided the area remains in permanent pasture. Under arable farming, where the crop is sown and seeded and that resultant crop sown and seeded year after year, change in type may come about in less than ten years.

Some Examples of Type Evolution in response to Habitat Conditions.

There are now in New Zealand certain high-production permanent grasslands over sixty years old. These presumably were originally sown with good types of English perennial rye-grass, cocksfoot, and

FIG. 1. PIECE OF TYPICAL NEW ZEALAND FIRST-CLASS PASTURE SWARD

The highly productive, highly competitive, long-seasonal-growth sward characteristic of the high fertility habitats in New Zealand, which have in themselves by automatic culling and selection evolved high-production strains of pasture-plants, seed of which is now being offered under the Government certification system.

white clover, but under more favourable climatic and soil conditions in New Zealand than in the land of their origin new specific types have been evolved, characterized by high production, high persistency, and long seasonal growth. It seems sound to accept these areas as constituting mother-seed production areas, and to expect that the progeny from these areas will hold to the type, for some years at least, under any habitat in the world where the soil and climate are suitable for the production of pasture.

Kentish wild white clover is the product of a relatively stable habitat characterized by moderately high-fertility soil, not overintense competition from taller-growing grasses, a product of the grazed pasture rather than hay or silage pasture, and in an area of moderately long dormant winter period. This type, on being transferred to a similar habitat in New Zealand, behaves identically to Kentish wild white clover in England. If, however, it is sown out on high-production, and particularly high-winter-production, grassland soil in New Zealand it is swamped by the intense competition. Again, if normal Kentish wild white has been sown under a gradually improving habitat, such as has probably occurred in New Zealand, it is safe to assume that out of Kentish wild white have been eliminated by competition effects all the lower-producing and winter-dormant types, and there has been gradually evolved a higher-producing strain, and from this a still higher-producing strain, until we have the high-producing, tall-growing, dense-foliaged, long-seasonal-growth strain of white clover characteristic of the highest production habitats found in New Zealand to-day. Areas of white clover of this type in New Zealand are now being located and registered under a certification plan as mother-seed areas.

Danish cocksfoot is another case in point. This is a type that has been evolved to produce seed under a habitat condition as far as climate is concerned too cold in the winter for sustained growth of cocksfoot. Danish cocksfoot sown in New Zealand still retains its sigh seed-production characteristics, and at the first frost burns badly and remains more or less winter dormant until the early spring, when a crop of flowering stalks is produced at the expense of foliage.

Similarly, strains of red clover and lucerne from Canada, Russia, Sweden, Austria, and Germany are winter dormant in New Zealand, probably for as long as they are in the country of origin. Montgomery red clover from Great Britain, however, is not so winter dormant, and this again is in conformity with the conception of characteristics inbred by habitat conditions. Montgomery red clover in New Zealand is as distinct from broad red clover when grown here as it is in England, and this irrespective of the soil conditions under which it is sown. Montgomery red, however, grown for, say, thirty years under high-productive and therefore highly competitive associations in New Zealand may develop into a uniformly higher-production type than the normal type produced under conditions as they exist in Montgomeryshire.

Further, British indigenous cocksfoot and the British indigenous rye-grass are both finer in the leaf, more dense but notably lower-producing under sward conditions, than the New Zealand cocksfoot or New Zealand rye-grass, and there is a danger if these were sown under high-production conditions in New Zealand that they would be swamped by rank volunteer growth such as Yorkshire fog, New Zealand white clover, or New Zealand rye-grass. Under moderately low-fertility

habitat conditions, however, British indigenous selections of cocksfoot and rye-grass are identical in New Zealand with those seen growing in the trial grounds at Aberystwyth in Wales.

Again, annually inclined types of herbage plants, which are largely the product of arable farming, behave in New Zealand identically with the same type grown in Great Britain, Europe, Australia, or elsewhere. Thus Dutch white clover behaves as an annual in New Zealand just as it does in Great Britain. Lombardy red clover and the Italian types of red clover are short-lived in England; they are the shortest lived red clovers yet tested in New Zealand, and this irrespective of the soil-type on which they are sown. Years of arable farming and of short rotation have left their mark on strain, just as years of permanent-grass-farming have left their mark; only in the first case annual types have been evolved, and the more arable the farming practice adopted the more truly annual the type. Short-rotation systems of farming have evolved the false perennial rye-grass types, the broad red clover types, and short-lived white clover types. In Australia Wimmera rye-grass is replacing in certain districts the somewhat later-maturing and longer-lived Italian rye-grass, and drought areas there have evolved their own peculiar types to harmonize with the short production periods between those of intense drought. Wimmera rye-grass, drooping clover, and quick maturing forms of subterranean clover may be regarded as types specially evolved by the drought habitats of Australia.

Changes in pasture-plant types such as cited have not come about in a year. Probably some thirty to forty years are required to change the type by habitat conditions alone. The plant-breeder and selector, working within definite and recognizable habitats, may introduce into commerce improved strains dominantly of the one type long in advance of what can be done by natural selection alone. Where it may take ten years or more for a certain inferior type to be eliminated under natural conditions, the plant-breeder by selection and culling may perform the same operation in considerably less time.

Recognizing the great part the habitat plays, however, what a wealth there is in the old pastures where high production and consequently high competition have ruled for sixty to eighty years. High production and consequently high competition are specifically stipulated for the reason that where soil fertility is low and consequently production is low there is room for low-production, free-seeding annual types to perpetuate themselves by reseeding. Similarly on heavy land where there is winter poaching, or where pastures are opened up in the autumn by drought or overhard grazing, conditions for reseeding are propitious and annual types may persist for many years by reseeding. In New Zealand Italian rye-grass is quite dominant on certain high-production country that has not been ploughed or sown for over thirty years. This is by reseeding, and for the most part these are pastures that have never been sown down with good perennial strains. Although, however, age of pasture alone is no guarantee of type, nevertheless it is to the old pasture, under inspection, trial, and certification, that we must go to get our mother-seed supplies as a nucleus for increase seed growing. The point it is specially wished to stress is that the best strains showing high production, long seasonal growth, and high persistency are to be found in the highly competitive grazing pastures of the world.

New Zealand, with its equable climate, high soil-fertility (natural, or induced by top-dressing), and its system of all-the-year-round grazing, has evolved a type or types that are going to prove invaluable to the grasslands of the Empire. Just as winter dormancy persists in a strain that has been evolved under cold climatic conditions irrespective of the country wherein the progeny of those types is sown, so also should non-winter dormancy hold to a certain extent, for some years at least, even though the strain evolved under milder winter conditions is sown under slightly more rigorous winter conditions. Temperature, of course, is a very limiting factor to growth irrespective of country and type, and there is probably a greater danger of non-winter dormant strains being winter killed than in the case of the markedly winter-dormant forms. It is certain, however, that winter-dormant types are of no value to a country where the winters are mild, and as a general practice it would appear sound that an importing country should look for its supplies of perennial pasture seeds from a good permanent-grassland country as mild or of somewhat milder winters than its own. Great Britain, therefore, should import its pasture-seed requirement from New Zealand or from the coastal areas of Australia rather than from Canada, America, or Europe.

Value of High Production in a Strain.

High production in a strain offers greater scope to the grassland farmer. A low-production strain, as with a low-production species, cannot respond to liberal treatment, and therefore a limit is set to what the farmer can accomplish by manuring, harrowing, drainage, and other aids to growth. He is limited by the potentialities of his species or strain. In New Zealand much work has been done on the grassland successions that arise as a result of alterations in the conditions of the habitat. Low fertility soils in New Zealand carry a sward of danthonia, hair-grass, sweet vernal, bay-grass, suckling clover, clustered clover, haresfoot trefoil, and the like; or brown-top may be quite dominant on colder, stiffer, and wetter soils. These pastures almost invariably carry a small percentage of white clover, cocksfoot, crested dogstail, Yorkshire fog, Poa pratensis, and rye-grass. If such a sward is systematically top-dressed and harrowed a change in the pasture association comes about. The lowest producers are the first to go; then the group a little higher in production, until finally there comes to exist a dominant rye-grass, white clover, and cocksfoot sward. This change is made possible through the inherent higher production capabilities of the rye-grass, cocksfoot, and white clover; and if, for example, we have a rye-grass of a low-production type that had a production capacity equal only to, say, brown-top, then it would be impossible to replace that brown-top by rye-grass, nor would there be much advantage in doing so. Under improved pasture conditions, therefore, where the aim of the farmer is high and still higher per-acre production, the value of inherently high-producing strains is easily realized.

In the grasslands of the world, of course, there is a place for low-production species where it is impossible to give cultural and manurial aids to the pasture. In New Zealand Danthonia pilosa, brown-top, Yorkshire fog, ratstail, suckling clover, Lotus major, clustered clover, &c., have their place, and these as climax associations represent the inherent possibilities for production that a soil growing them is capable of producing in its present state. A high-producing rye-grass would starve on

such a soil-type, and it is a moot point whether it is worth while breeding a low-production rye-grass that would fit naturally and blend in with the other dominants of such a sward.

Similarly, it is probably not worth while to breed high-production strains of danthonia, brown-top, &c., when we have already other plants of inherently high-production capabilities. High production in any species is only possible under adequate feeding. Paspalum dilatatum is potentially an extremely high-production species, but in New Zealand it is high producing only on high-fertility soils. When paspalum is sown and farmed on low-fertility soils that in nature support only a danthonia-dominant sward, the paspalum, after having colonized the ground completely, does not produce as much green leaf as does the danthonia. New Zealand certified rye-grass will persist almost indefinitely on virtually any soil-type in New Zealand, but on dominant danthonia country or dominant brown-top country, unless top-dressed, it produces probably less than either of these, and it is not until the habitat conditions are improved that rye-grass shows superior to danthonia or brown-top. A low-production rye-grass sown on natural brown-top country would undoubtedly make a better permanent sward than would a high-production rye-grass on that same soil-type; but the point is, would it be much superior in production and carrying-capacity to the natural brown-top sward so easy to secure on that country?

The same applies to cocksfoot, red clover, and white clover. There are some extremely fine-leaved but low-production forms of cocksfoot within the British indigenous cocksfoot associations, and the surmise is that these forms would make a closer sward on low-fertility soils than would the broad-leaved, higher-producing types. Wild red clover from the Kent pastures represents a type inherent to low-fertility soils. Kentish wild red clover may do better on those low fertility habitats than any other forms of red clover, but one would not for a moment advocate wild red clover where the soil conditions were good enough to grow high-producing forms of Montgomery red clover.

Again, in Montgomery red clover there are innumerable forms, some at a glance almost indistinguishable from white clover, and certainly not more highly productive. Is there any point in selecting a red clover that is not more highly producing than white clover? Montgomery red clover is a splendid permanent-pasture or long-rotation pasture type, but selections that tend to be high producing rather than low producing should be the aim. New Zealand is now growing Montgomery red clover, and the possibilities are that under New Zealand conditions a high-producing type rather than a low-producing type will automatically become segregated out.

Kentish wild white clover is a comparatively low-producing type, and because there is no other permanent clover that is lower in production than Kentish wild white this type must ultimately find wide application in the sown grasslands of the world. The certified New Zealand white clover is a high-production type, and while it may not compete successfully with Kentish wild white on low-fertility soils, because of its higher soil-fertility demand, yet given high-production conditions New Zealand white clover will out-yield and replace Kentish wild white because of its natural inherent inbred high-producing characteristics.

SOIL FERTILITY AS A FACTOR IN CHOICE OF STRAIN.

Our choice of strain in pasture types is governed by soil and climate, or by the ability of the farmer to fertilize and otherwise improve the conditions for growth. Manurial responses and the return from the use of fertilizers are largely dependent on the strain of our herbage plants. In other words, the success of manurial applications in a sense is dependent on strain. High production is not possible from low-producing strains, however much manure is applied, nor is winter and early spring production possible from winter-dormant strains. New Zealand cocksfoot, therefore, should respond to manuring for out-of-season growth markedly better than Danish, Russian, Norwegian, or American. It will pay better to manure New Zealand certified rye-grass than any false perennial rye-grass, whether New Zealand grown or imported; and as far as the Agriculture Department's trials go up to the present it will pay better to manure New Zealand certified perennial rye-grass than any other perennial rye-grass yet tested. New Zealand white clover has the ability to produce out-of-season growth, and thus makes phosphate manuring for late autumn, winter, and early spring more profitable than with any other type of white clover.

(To be continued.)

PELLET AND LICK FEEDING OF STOCK.

B. C. ASTON, Chief Chemist, and J. LYONS, Director of the Live-stock Division, Department of Agriculture.

THE advantages of supplementary feeding of sheep in the three months of winter, during which the animals are either stationary in growth or are losing weight, are too obvious to be stressed. On typical sheep-country the land is usually hundreds of feet above sea-level, often inland in situation and exposed to wind, snow, and rain, the soil poor, and the short sweet pasture which is said to be typical of the food requirement of sheep is deficient, for in winter, when growth practically ceases, the sheep is forced to forage farther afield to obtain a ration deficient in quantity and quality, consisting of older growth.

During this period the animal probably cannot obtain the 3 lb. of dry matter a day which is held to be the normal requirement of each full-grown sheep, and much of the fodder it is lucky enough to get then is deficient in mineral matter. It is then that the animal is compelled to live partly on the body reserves which have been stored up during the periods of plenty—spring, summer, and autumn—through which it has passed. Several pounds of live-weight are therefore lost in the months of June, July, and August in those sheep which continue on pasture without the aid of supplementary feeding (roots, &c.), which on many runs it is not practicable to grow. The feeding of concentrated meal foods to sheep is quite possible, but the large outlay in cash is a decided objection in this period of low returns to the farmer.

Pellet-feeding is a method of feeding automatically both concentrated meal foods and mineral foods to sheep in one operation, without the need for special troughs or the necessity for rounding up the sheep to feed them. The meal foods—ground linseed, coconut (copra) from which

the excess of oil has been removed, and pea-meal (and there is no reason why fish- or meat-meal should not also be used)—are primarily designed to make the mineral part of the supplement attractive to sheep so that when the animal has learnt to eat the pellets it may continue to do so, the attraction being maintained by the nutrient meals added. These contain energy and fat-producing foods with a high degree of digestibility, and therefore in feeding mineral foods by this method the effect of the non-mineral concentrated foods, or the possible effect of suddenly stopping the use of such foods, may be overlooked. A flock of sheep grazing in winter on malnutrition country, on pasture to which ration is added a concentrated meal, may feel the stoppage of the supplement in the spring when the young growth is so different chemically from what they have been receiving.

It seems obvious that when compound pellets are fed to sheep in greater quantities than the bare amount necessary to secure a proper absorption of minerals the technique of the method requires to be studied. It should also be borne in mind that the market prices obtained by sheep-farmers at present hardly warrant the expenditure of £15 a ton on supplementary food of which a single sheep may eat several ounces per day. Assuming that they are given pellets which cost 3½d. per sheep weekly for the three months of winter it would cost 3s. 6d. for each sheep, but this could hardly be considered a practicable proceeding in the light of the present price of wool. The experience in Scotland by those who use this method is that pellets when properly made can be scattered on the ground, and the sheep have acquired such a liking for them that immediately the attendant appears in sight they muster themselves from the surrounding hills in an endeavour to obtain more than their share, but by scattering pellets judiciously on the ground the average consumption may be equal for all members of the flock. This experience has been duplicated in New Zealand. It has been found that when ultimately after some difficulty the sheep have been induced to take the pellets they become quite greedy for them and are willing to consume any amount that is put out at a given time. There is hence no wastage through non-consumption of mineral or meal food.

The giving of salt licks to stock is an admirable method of feeding minerals. The principal is that common salt, which is palatable and sought after by most grazing-stock, is a substance of undoubted value in maintaining the thriftiness or health of all vegetable-feeding animals, a fact which has been known since the very earliest times. The other minerals required are apparently not so attractive as common salt, and are not eaten to the same regular extent as the salt put before them. It has therefore become the practice to mix any mineral required with a large quantity of coarse or fine agricultural salt and feed it as a powder lick, or alternatively to put it out in the paddocks after pressing the ingredients into a brick or block in order to minimize the wastage by rain. Both methods are extensively practised. In the case of the powder lick it is necessary to have some box or trough protected from the weather, from which receptacle the lick may be fed. In this way such substances (presumed to be tasteless to animals as they are to human beings) as calcium phosphate, calcium carbonate, iron carbonate, iron oxide, charcoal, and sulphur are given mixed with salt. Some other mineral foods which are soluble and therefore presumably can be tasted

by the animals, and which are equally necessary, but are used in very much smaller quantities, are also mixed in with the salt lick. These are iodine administered as potassium iodide, magnesium sulphate (Epsom salts), sodium sulphate (Glauber salts). These presumably are not repulsive to the animal, although magnesium salts have a bitter taste to human beings.

It has been found in the cases of the bush-sickness region that it is undesirable to mix soluble iron salts in the lick for sheep. The particular soluble salt used was the double iron and ammonium citrate. Many formulæ have been published in which the use of ferrous sulphate is advocated, but how far this is attractive or nauseous to sheep has yet to be determined. The experiment with the double citrate certainly indicates that the taste might prevent sheep taking it. The iron sulphate, however, is useful perhaps in combating parasites, but for this purpose it would be more efficacious to administer the material to each animal as a bolus or drench. When iron is required in a lick as food-iron for continuous use it would be preferable to use finely ground limonite (hydrated oxide of iron) instead of the iron sulphate.

Now, although in the Dominions generally where sheep-farming is practised on a large scale there is no difficulty in getting sheep to take a salt lick, in New Zealand there are localities where farmers report that the animals will not take it, and this may possibly be due to the large amount of salt which is contained naturally in the pasture when this occurs in areas near the sea or liable to be affected by salt-laden gales from time to time. Whether the sheep in these districts can be induced to take salt licks containing other minerals is not known at present, but if it is ultimately found that there are large stretches of country deficient in some mineral where the animals will not take a salt lick the only remedy would be to give the minerals mixed with meal as in the pellet method, or with ordinary molasses in the case of cattle.

Comparing the three methods of giving mineral foods to stock (1) by pellet, (2) by salt-powder lick, (3) by salt brick or block :—

The pellet method of feeding is comparatively costly, requiring some patience to inaugurate on a run owing to the time taken to teach the animals to take the pellets, but when established as a practice there is no wastage due to weather and no expense is incurred in providing troughs for feeding.

The salt-powder lick is necessary at present when phosphates are used, as although much time and money has been spent by various organizations and by the Department of Agriculture in endeavouring to make a brick or block with phosphates which would stand up to transport and keep its shape in the field, this has not been achieved. In using a powder lick a trough or feeding-box is of course necessary, and the model shown elsewhere in this issue of the *Journal*, used by Mr. H. M. Besley, is recommended as cheap and efficient.

Block or brick licks of various sizes can easily be made where phosphates are absent from the mixture. These can be hung up to fences when small in size by means of a wire staple let into the brick, or may simply be thrown on the ground, the salt being so little soluble in block form that the loss from weather is negligible. In a subsequent issue of the *Journal* it is intended to discuss the composition of suitable licks for various districts.

ORCHARD SPRAYS IN NEW ZEALAND.

II. THE LIME-SULPHUR SERIES.

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ABOUT the year 1851 Grison, at Versailles, France, by boiling lime and sulphur together in water, produced a compound known as *eau Grison*, which was the forerunner of the spray so familiar to-day under the name of lime-sulphur. His material appears to have been used for a few seasons and then forgotten, since it was not until about 1881 that this spray again came into prominence, on this occasion being used in combination with salt against San Jose scale in California. The use of a combination of lime, salt, and sulphur was suggested in this connection, since it had proved successful shortly before in Australia against sheep-scab (Pierce, 1900, p. 49). In 1892 it was recommended as an insecticide in New Zealand (Hanlon, 1892). In experiments on the control of leaf-curl and scales of peaches Pierce (1900, p. 155) found that the salt was unnecessary, and so lime-sulphur in its present form came into use as a winter fungicide and insecticide.

Spray injury resulting from the use of bordeaux mixture against black-spot of apples led to the development of lime-sulphur as a summer spray by Cordley (1908) in Oregon, and its success in this connection led to its general adoption in New Zealand about the year 1912 (Campbell, 1916).

COMPOSITION OF LIME-SULPHUR.

This spray is prepared by boiling together in water measured quantities of lime and sulphur. The product, when filtered, is a clear reddish-amber liquid which chemically consists of calcium monosulphide, calcium polysulphides, calcium thiosulphate, and possibly small quantities of calcium sulphate. The amounts of these compounds vary according to the methods of preparation, the proportions of lime, sulphur, and water used, and the apparatus in which the material has been manufactured. As will be shown, the polysulphides alone possess fungicidal and insecticidal properties, consequently the worth of a lime-sulphur may be measured by the percentages of these ingredients present in solution.

UNIT OF MEASUREMENT.

In order that a given strength of spray may be applied at any specified time it is necessary that some unit be utilized for ascertaining the strength of the concentrated solution employed. For this purpose three methods have been used :—

(1) *Specific Gravity.*—Ever since lime-sulphur came into general use it has been customary to base dilutions on its specific gravity, readings being given generally in degrees on the Beaume hygrometer. That this is not a reliable indicator has been suggested by many, and demonstrated by Goodwin and Martin (1925), who showed experimentally that there was often no correlation between the specific gravity and the polysulphide content of the solution. Their work has been abundantly supported by the analyses conducted upon the lime-sulphurs used in New Zealand. As an example (one of many) it was

found that in two commercial lime-sulphurs with a specific gravity of Be. 33°, one had a polysulphide content of 11·92 per cent., the other a content of 18 per cent.

A second disadvantage of such a unit of measurement is that the specific gravity may be affected materially by the addition of foreign substances of no value as fungicides or insecticides. In one example of a local preparation analysed it was found that although the specific gravity was Be. 34° the polysulphide content was only 13·7 per cent., whereas another brand with a test of Be. 33° had a polysulphide content of 18 per cent.

(2) *Total Sulphur Content.*—In the United States of America it is customary to express analyses of lime-sulphurs in terms of the total sulphur content. But as Eyre, Salmon, and Wormald (1919), and Goodwin, Martin, and Salmon (1930) have shown, this is not an index of the fungicidal value of a lime-sulphur. These workers have shown, and this is confirmed by our numerous analyses, that the calcium thiosulphate and calcium monosulphide content of different brands varies considerably, and as these substances are not appreciably toxic to fungi and insects it is evident that the total sulphur content cannot be used as a basis of dilution.

(3) *Polysulphide Content.*—Tartar (1914) found that the insecticidal value and Horton and Salmon (1922) the fungicidal value of a lime-sulphur is dependent upon its polysulphide content, other ingredients present in solution being of no value at the concentrations present. According to Goodwin, Martin, and Salmon (1930) the concentration of the polysulphides is not affected by the type (being the same whether the polysulphide is in the lower or higher forms) nor by the base (ammonium, sodium, potassium, calcium, or barium) employed. Such being the case, it is evident that these compounds form a reliable guide to the dilutions at which any particular make should be employed. Goodwin (in Anonymous, 1926) stated that when a summer spray containing a 0·1 percentage of polysulphide was used it proved fungicidal to hop powdery-mildew. This figure corresponds with the percentage of these compounds present in summer dilutions of lime-sulphur tested during the past two seasons in New Zealand, and may therefore be used with safety as the unit for computing the different strengths to be applied according to the season of the year. Given the percentage of polysulphide present in any lime-sulphur, it is evident that from the table of dilutions supplied below an orchardist may arrive at the correct strengths at which to apply the diluted spray. Under the provisions of the Fungicides and Insecticides Act, 1927, it is proposed to draft regulations in such form that manufacturers will be required to place upon each container this percentage figure. In order that ambiguity may be avoided in the interpretation of this provision, it is advisable that the polysulphide percentages be determined by the modified Chapin method employed by Goodwin and Martin (1925), and given in percentages by weight (W/W).

Table of Dilutions.

Given the percentage polysulphide content of any lime-sulphur, the following table of dilutions should enable orchardists to apply each spray at the approximate strength recommended, irrespective of the brand used.

Polysulphide Content in Percentages W/W.*	Gallons of Water to be added to One Gallon of Concentrate to make a Spray of desired Strength: Sprays containing a Polysulphide Content of			
	1 per Cent.	0·2 per Cent.	0·1 per Cent.	0·083 per Cent
8	8	40	80	96
9	9	45	90	108
10	10	50	100	120
11	11	55	110	132
12	12	60	120	144
13	13	65	130	156
14	14	70	140	168
15	15	75	150	180
16	16	80	160	192
17	17	85	170	204
18	18	90	180	216
19	19	95	190	228
20	20	100	200	240

* Taken as referring to the nearest whole number: Thus 10·35 = 10 per cent., 10·60 = 11 per cent.

Reference to this table will show that the older expressions of 1–10, 1–50, 1–100, and 1–120 have no significance, since dilution is directly affected by the percentage of polysulphide in the concentrated solution. Consequently, ambiguity will be avoided if any given spray is referred to by its polysulphide content: Thus a spray containing 1 per cent. is recommended for application during the period between dormancy and bud-movement; 0·2 per cent. for from green-tip to pre-pink; 0·1 per cent. for summer applications; and 0·083 per cent. for autumnal applications on apple varieties liable to spray-burn, and for stone-fruits.

"HOME-MADE" LIME-SULPHUR.

Numerous inquiries have been received from orchardists as to the best process to be followed in the preparation of "home-made" lime-sulphur. Before discussion is possible it is necessary to ascertain what is meant by the term "home-made." Our analyses have shown that the lime-sulphurs used in New Zealand fall into three groups, which may be defined by the polysulphide percentages present in the concentrate, and appear to exist in consequence of the process of manufacture employed.

Group 1: Lime-sulphurs of this group possess a high polysulphide content (16 to 19 per cent.), a low calcium thiosulphate content (under 1 per cent.), and are prepared by boiling under pressure in closed containers, consequently materials are not exposed to the air during preparation.

Group 2: These contain a moderate polysulphide content (10 to 13 per cent.), a high thiosulphate content (2·5 to 3·75 per cent.), and are prepared by the aid of steam heat in open vats exposed to the air.

Group 3: These contain a comparatively low polysulphide content (7 to 10 per cent.), a relatively high thiosulphate content (1·75 to 3 per cent.) and are prepared by boiling over open fires in vats exposed to the air.

To the third group belong "home-made" lime-sulphurs with which we are concerned. Their low polysulphide content is not in any way detrimental, since they will give comparable results in the field with more concentrated solutions, provided they are diluted according to the table given above. Analyses of eighteen batches of these home-made solutions show the polysulphide content to vary from 7 to 10 per cent., this variation being induced by differing proportions of lime, sulphur, and water used, and the different periods of boiling.

A survey of the literature shows that there exist considerable differences of opinion as to the proportions of lime, sulphur, and water to be used, and the length of time to boil. Such differences appear to have resulted largely from attempts to measure the value of the material by its specific gravity. It would appear that one of the most economical formulæ in use is that in which 100 lb. of sulphur and 50 lb. of lime are boiled for forty-five minutes with 50 gallons of water, as a concentrate is obtained which contains about 9 per cent. of polysulphides, and the waste sediment formed is not unduly large. Variation in the polysulphide content may be induced by altering the proportions of sulphur to lime, by increasing or decreasing the water content, by altering the time of boiling, or by using materials of varying degrees of purity. As it is desirable that sprays be applied at the dilutions recommended, orchardists preparing their own solutions are advised to avoid any alteration in the preparation of each batch, since variation in the polysulphide content may be caused by altering any of the factors mentioned.

The sediment formed during the preparation of lime-sulphur consists of calcium sulphate, calcium carbonate, free sulphur, and additional impurities present in the ingredients. As all these materials, in the quantities present, are worthless as spray materials, it is obvious that this sludge has no spray value.

SELF-BOILED AND DRY-MIX SPRAYS.

Owing to the damage frequently experienced by applying summer sprays of lime-sulphur, attempts have been made from time to time to introduce compounds of lime and sulphur less liable to cause injury. Of these the following preparations have come into more or less general use :—

Self-boiled Lime-sulphur.—This was recommended by Scott (1909) in place of lime-sulphur as a spray for the control of brown-rot of peaches. It is prepared by mixing quicklime with sulphur and adding water, advantage being taken of the heat generated by the slaking lime to bring about a certain amount of chemical action between the lime and the sulphur. The resultant spray consists of a mixture of lime and sulphur particles held in a weak solution of lime-sulphur. The fungicidal value of such a spray is dependent upon the weak lime-sulphur formed and the free sulphur in the mixture. A more exact spray could be prepared with less effort by adding colloidal sulphur at the rate of 2 lb. per 100 gallons to a lime-sulphur containing 0·083 per cent. polysulphide.

Dry-mix Sulphur-lime.—This spray was introduced by Farley (1923), and was prepared by mixing 8 lb. of sulphur, 4 lb. of hydrated lime, and 8 oz. of calcium caseinate spreader with 50 gallons of water.

Robinson (1924) suggested that the spray be modified by the use of 2 quarts of skim-milk in place of the calcium caseinate spreader, this alteration producing the spray known as the "Oregon cold-mix sulphur-lime."

Both are but mixtures of lime and sulphur with a spreader, and as neither lime nor spreader is fungicidal to any appreciable extent, it is evident that their value as sprays is governed by the sulphur content and the type of sulphur used. Such being the case, it would be preferable to use a colloidal sulphur at the rate of from 2 lb. to 4 lb. per 100 gallons of water.

DRY LIME-SULPHUR.

In the United States several manufacturers have placed upon the market a material known as dry lime-sulphur, which is a coarse powder prepared by the dehydration (in the presence of a stabilizer, such as sugar) of commercial concentrated lime-sulphur. The advantages claimed are saving in freight due to the extraction of water, avoidance of losses through leaking containers, and a reduction in the amount of spray injury. The high price of the dried product when considered in relation to the quantity necessary to prepare the diluted solutions, and its uncertain composition, preclude the use of this material in preference to liquid concentrations of local manufacture. Robinson (1924) has shown that there occurs in the dry material partial decomposition of the polysulphides, with a consequent increase in the thiosulphate content.

EFFECTS OF LIME-SULPHUR UPON FUNGI, INSECTS, AND PLANTS.

When a diluted solution of lime-sulphur is applied to a tree it undergoes certain chemical changes, with the result that ultimately only calcium carbonate, calcium sulphate, and free sulphur in a finely divided state remain. The polysulphides are converted into free sulphur, the monosulphide to hydrogen sulphide, and the thiosulphate into calcium carbonate and sulphate, and possibly free sulphur.

Action on Fungi.—It is not known whether the polysulphides are directly fungicidal, as has been suggested by Eyre and Salmon (1916), or whether lime-sulphur acts on account of the free sulphur liberated as a result of its decomposition, as has been claimed by Young (1922). It is probable that its fungicidal value over a period is due to this free sulphur, since, shortly after application, this appears to be the only substance present upon the tree in addition to the inert materials mentioned. It does not appear that the hydrogen sulphide produced as a result of the decomposition of the calcium monosulphide has any material effect, since Horton and Salmon (1922) have shown that the monosulphide when tested alone had little fungicidal value.

Action on Insects.—It would appear that the insecticidal action of lime-sulphur is due (Tartar, 1914) to (1) its power of absorbing oxygen (thus asphyxiating insects); (2) its ability to soften wax newly secreted on the margins of scales (thus tending to imprison the young by causing the scale cover to adhere firmly to the tree); and (3) by the free sulphur which is liberated (known to possess a certain insecticidal value).

As an ovicide lime-sulphur appears to be of little value, according to Theobald (1914) and Parker (1923), and this has been confirmed under New Zealand conditions by the Entomologist of this Station, Mr. J. Muggeridge, who found it was not toxic to the eggs of European red-mite when tested as a 1-per-cent. polysulphide solution.

Scott and Siegler (1913) claimed that it acted as a stomach poison against fall web-worm and codlin-moth; but Theobald (1914) found it had too slight an effect in this connection to permit of its replacing the arsenic sprays.

Action on Plants.—Leaf-scorch and fruit-russet have frequently been experienced following summer applications of lime-sulphur in New Zealand, and elsewhere it has been found to cause defoliation and dropping of young fruits. Numerous theories have been expounded to account for this injury, the position being well summarized by Shoemaker (1924), who has grouped them under the following heads: (1) Injury due to the soluble polysulphides; (2) to absorption of lime-sulphur by the chlorophyll; (3) to the effects upon the spray of sunlight, heat, gas, acids, and oxidation; (4) to the minuteness of the sulphur particles deposited as a result of its decomposition. Shoemaker concluded that it was not possible as yet to arrive at any definite conclusion as to whether any one factor was responsible for lime-sulphur injury under all conditions.

It is certain that in New Zealand, at any rate, frequent cases of lime-sulphur injury have resulted in consequence of applications being made at too great a concentration, owing to the practice of determining strengths by the specific gravity of the solution.

Uses of Lime-sulphur.

It has been customary in New Zealand to use this spray as a winter insecticide against scales, woolly-aphis, and red-mite eggs, and as a winter fungicide for both pome and stone-fruit diseases. As a summer spray it has been used as a fungicide against leaf-rust and brown-rot of stone-fruits, black-spot and powdery-mildew of apples, and as an insecticide against red-mite and young scales, and to a less extent against aphis.

Experiments conducted during the past two seasons (previous experiments with summer sprays cannot be considered, since the concentrations at which they were applied are unknown) with sprays diluted in accordance with the polysulphide content have shown that lime-sulphur will combat black-spot and powdery-mildew without appreciable injury to fruit or foliage. It is reasonable to suppose that at these new dilutions it should prove equally effective for control of brown-rot and leaf-rust of stone-fruits, but as yet we have no experimental data in support of this. As a winter fungicide it has proved to be slightly inferior to bordeaux mixture as a foundation spray against black-spot, and decidedly inferior to both bordeaux and burgundy mixtures against leaf-curl of peaches.

Red-mite has been held in check during the summer by applications at ten-day intervals of sprays containing 0·1 per cent. polysulphide. As extension of the interval between each application has given unsatisfactory results, it is evident that it is not a satisfactory spray

for this purpose. As a winter spray it has failed to destroy red-mite eggs; but it has given satisfactory results against San Jose scale, even at dilutions in excess of those now recommended.

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PULPY KIDNEY DISEASE OF LAMBS.

NOTES ON INVESTIGATIONAL WORK IN 1931 SEASON.

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Notes on the 1930 season's work on pulpy kidney disease, published in this *Journal* for May, 1931, recorded that a highly toxic substance was present in the small intestine of affected lambs, and that it was intended to verify this and search for the cause of it during the 1931 season.

The centre from which the pulpy kidney work had been carried out since the commencement of the present investigation in 1926 was Ranfurly, in Central Otago, but the progress of the work was greatly hampered there by the lack of such facilities as electric power and a good water-pressure, and although it was unfortunate to leave such a district, where one knew the affected farms well and the farmers were accustomed to co-operating with us, it was felt that more rapid progress would be made in a centre such as Oamaru, where there were better facilities for detailed work.

Through the courtesy of the Waitaki Farmers' Freezing Co. we were able to fit up a small laboratory at the Pukeuri Meat-works, and to use that as headquarters. It is a pleasure to acknowledge here the kindness and consideration shown by the works manager, Mr. McEwen, and his staff.

The articles on this disease that have appeared each year in the *Journal* have only been summaries of the much more detailed reports that have been submitted to the Department, as it has been considered unnecessary to burden readers with technical matters concerning research as to the actual cause of the disease until some definite pronouncement could be made.

When the second (1928) year's work on the subject had been completed we were of opinion that the cause lay in the production and absorption into the lamb's body of toxins formed in the intestines, and suggested (Departmental report) that an organism such as *Bacillus welchii*, or one of a similar nature, was a very likely culprit. Evidence in support of this view was sought during the following season, but owing to the lack of facilities at Ranfurly referred to above this could only be done by various indirect means, none of which was successful. Plans were made for a more definite search for the presence of toxins in the gut contents during the 1929 season, but owing to the writer's absence from the country they were not carried out till 1930. This time positive evidence of abnormal toxin-production in the small gut was obtained, and, as this was the first real clue to the cause of the disease, full details of the work and results were sent to various research workers in Australia, England, and elsewhere, who were interested in the same problem, in addition to the summary published in the May, 1931, issue of the *Journal*.

A fact that was not mentioned in last year's published report was that the toxin in the affected lamb's intestine was readily destroyed by quite a moderate degree of heating, and that there was strong

presumptive evidence that it was the toxin of some particular micro-organism. In the *Veterinary Journal* of September, 1931, Montergomerie, a veterinary research worker in North Wales, published the results he had obtained along similar lines, which amply confirmed our own.

The 1931 season's work at Oamaru was hindered to a great extent —just as was the previous year's at Ranfurly—by scarcity of affected lambs to work on. It had been an extremely bare, dry winter in North Otago, with the result that the ewes were not in their usual condition at lambing, and shortage of feed after lambing still further reduced the milk-supply. In spite of this, however, it was possible to confirm the presence in the small intestine of a highly potent toxin that was still present when the material was passed through a bacteria-proof filter, and was easily destroyed by heat. Had a plentiful supply of affected lambs been available, it was intended to attempt the identification of the organism that was producing this toxin by finding what sort of antitoxins would or would not neutralize it.

With few exceptions, the germs that produce powerful toxins are of the class known as anaerobes (that is to say, they cannot be cultivated except in an atmosphere from which the oxygen has been removed), and this, together with certain other features of the disease, and the fact referred to above that *Bacillus welchii*, which is an anaerobe, was considered a likely cause on theoretical grounds, all helped to narrow down the search. In 1930 one attempt was made to neutralize the toxin in the gut contents with the antitoxin against the lamb dysentery bacillus, which is closely allied to *B. welchii*, and whose antitoxin will neutralize the toxin produced by that organism as well as its own. No neutralization occurred. This season, again, only a very small amount of this type of work could be done, but lamb dysentery antitoxin was tried once more and failed, and so did an antitoxin prepared against the malignant oedema organism. Although we do not place any reliance on our own results in this connection, in view of the small number of experiments made, it may be said that Montergomerie had similar results, and also tried *Bacillus oedematiens* antitoxin and found it useless.

Concurrently with this work the small-gut contents of the few suitable affected lambs that were available were cultured, and an organism very similar to *B. welchii* was obtained in almost pure culture from them. These cultures were brought back to Wallaceville for further study, and proved exceedingly interesting. They had every appearance of being *B. welchii* cultures, and produced toxins which killed mice in a manner identical with those killed by the lamb gut toxins, but it was found that in spite of appearances the organisms were not strains of *B. welchii*, because *B. welchii* antitoxin would not neutralize their toxins. (Toxin-antitoxin trials are the recognized criteria as to whether similar toxin-producing organisms are identical or not.)

Some antitoxin was then obtained from Bennetts, a veterinary research worker in Western Australia, who had discovered a new organism, also similar to *B. welchii*, as the cause of a sheep disease having many points of similarity to pulpy kidney disease of lambs, although it affects adult sheep generally. He had named his organism

Bacillus ovitoxicus. On testing his antitoxin against the strains obtained from Oamaru lambs it was found to neutralize their toxins very strongly.

When this was discovered it was decided not to publish the results till a series of standardized toxins and antitoxins could be obtained from England, with which to put the Oamaru strains through a very thorough test. This was considered necessary, because if the Oamaru strains were actually the same as *B. ovitoxicus* then lamb dysentery antitoxin should have neutralized their toxins, and in the few trials made (see above) the toxin in the lambs gut had not been so neutralized. Moreover, it was hoped to show by experiments on lambs in the early spring that these strains could actually set up the disease.

This decision was unfortunate as it happens, and has been changed, because a publication lately received from Australia—the *Journal of the Council for Scientific and Industrial Research*, February, 1932—gives a brief account of similar work on pulpy kidney carried out by Oxer, in Tasmania, in which he has isolated organisms similar to ours in New Zealand. He not only considers these identical with Bennetts's *B. ovitoxicus*, but has obtained fair evidence that this is, in fact, the organism which causes the disease.

It must be stressed in conclusion that these findings in no way interfere with the view expressed in previous articles that nutrition has a great predisposing influence. For some years now it has been the writer's view that a form of digestive disturbance occurred which gave some organism the opportunity it would not otherwise have had to grow and produce its toxin in the small intestine, and that the reason why the incidence is highest when the lambs are doing best is that they are getting abundant (perhaps overabundant) milk, and hence are more liable to digestive disturbance than they would be if they had less milk and more exercise.

Digestive disturbances from other causes than a too abundant supply of milk undoubtedly occur among lambs, especially at the age of about three weeks, when they are changing over from suckling only to suckling plus grazing. It is probably these conditions which predispose to the disease, and thus account for the losses that sometimes occur among lambs which are in only moderate condition.

In all probability the beneficial effect of yarding for twenty-four hours every five to seven days is due not only to the temporary starvation incurred, but to the fact that the ewe's milk when she comes out of the yards is reduced in quantity but contains an unusually large amount of fat. The effect of this on the lamb's empty stomach and intestine is probably that of a mild but efficient laxative.

Testing of Rye-grass Seed.—Whenever permanent pastures are being laid down and perennial rye-grass is included in the mixture, the Department of Agriculture recommends that certified perennial should always be used. However, it may not always be possible to secure certified seed, and in such cases farmers are urged to demand from the merchant who is supplying non-certified seed a guarantee that the seed has been tested by the Department's Seed-testing Station with ultra-violet light, and that it has been reported to be a perennial type. Attention to the type of rye-grass sown is of paramount importance in the laying down of permanent pasture.

WEED HOST PLANTS OF CLUB-ROOT IN NEW ZEALAND.

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THE following experiments have been conducted to determine the weeds upon which club-root, *Plasmodiophora brassicae*, may live in New Zealand.

Material for testing was secured by collecting seeds from cruciferous weeds during the summer of 1928–29. The seeds were sown on club-root-infected soil and the seedlings examined microscopically for the presence of the disease. In all, five sowings were made, and while four of these produced a number of infected plants, only two are considered as having afforded ideal conditions for the development of the disease. In the others, damping-off, cold weather, or unsuitable soil permitted of tests that were only partially satisfactory.

In one test, in which club-root developed strongly on most species, the roots of members of those species resisting infection were dipped in a spore suspension and transplanted to boxes wherein the organism had developed freely.* No further species became infected. Those resisting infection under these conditions were American cress (*Barbarea verna*), *B. stricta*, *B. vulgaris*, and twin cress (*Coronopus didyma*). In one sowing on unsuitable soil club-root failed to develop, but the roots of all plants showed small definite isolated swellings 1·5–2·5 mm. high by 6–8 mm. long and up to 3 mm. wide inhabited by a species of eelworm. The plants so attacked were *Barbarea verna*, *B. stricta*, *B. vulgaris*, *Diplotaxis tenuifolia*, *Cardamine heterophylla*, *Erophila vulgaris*, *Lepidium ruderale*, *Sisymbrium officinale*, *Alyssum calycinum*, and *Brassica oleracea*. Though similar lesions occurred on *Lepidium campestre*, *Brassica campestris*, and *Raphanus sativus*, neither eelworms nor other causes were in evidence under the microscope.

In the accompanying table is shown the infections resulting in four tests in which seed was sown on infected ground. In the second test, conducted in a glasshouse, only a few species were sown, all of which are recorded. In the other tests, though most of the species were sown, only those that grew normally are recorded. The table also indicates whether the species mentioned are common to field, garden, or wayside, &c., and reference is also made to papers in which are recorded the results of previous infection tests by other workers.

Of those plants infected, *Erophila vulgaris*, *Cardamine heterophylla*, *Sisymbrium orientale*, and *Diplotaxis tenuifolia* do not appear in the available lists, and are believed to be unrecorded hosts. The susceptibility of *Erophila vulgaris* is of little practical importance in New Zealand, as it grows in the arid area of Central Otago, which is not generally considered subject to club-root. *Cardamine heterophylla*, a native of the bush fringes and clearings, may prove of more importance through perpetuating club-root spores dropped in dung of stock. *Sisymbrium orientale* and *Diplotaxis tenuifolia* are of only limited

* The check of transplanting usually, though not always, appears to increase the susceptibility of plants to club-root.

Club-root Infection Data, &c.

Key to distribution of hosts: F = field weed; W = wayside weed; G = garden weed.

Host Plant.	Natural Distribution of Hosts.	Test 1.		Test 2.		Test 3.		Test 4.		Infection recorded previously by
		Number of Plants	Number clubbed.	Number of Plants.	Number clubbed.	Number of Plants.	Number clubbed.	Number of Plants.	Number clubbed.	
Barbarea stricta ..	W G	61	..	61	..	31	..	..		Cunningham, 7 per cent.
Barbarea verna ..	W G	46	..	116	..	46	..	35	..	..
Barbarea vulgaris ..	W G	12	..	46	..	12	..	..	..	Naoumoff, 1 plant = 6 per cent.; Hammarlund.
Brassica arvensis ..	W F	26	..	..	..		..	51	51	Halsted, *B. sinapistrum*.*
Brassica campestris ..	F	30	30	89	63	3	2	68	65	Cunningham, 5·5 p.c.; Naoumoff, 6 per cent.
Brassica oleracea—										
Gisborne	Coast	22	3	109	78	..	..	..	..	..
Waikanae ..	W	.	..	..	..	..	..	25	25	..
Oamaru	Coast	22	..	..	..	..	..	12	12	..
Cardamine heterophylla	Bush	4	2	33	24	..	..	10	10	..
Coronopus didyma ..	G F W	11	..	20	..	8	..	67	..	..
Coronopus procumbens	F W	.	..	..	..	4	..	22	..	..
Capsella bursa-pastoris	F G	..	..	1	1	1	..	7	6	Halsted, Cunningham, 57 per cent.; Naoumoff.
Cherianthus chieri ..	Cultivated	6	..	..	..	3	..	21	18	Halsted.
Diplotaxis muralis ..	G W	48	2	..	..	..	..	1	1	Naoumoff, 10 per cent.
Diplotaxis tenuifolia ..	W	55	9	..	..	..	..	36	36	..
Erophila vulgaris ..	F	..	..	28	1	..	..	51	11	..
Lepidium tenuicaule ..	Coast	50	..	..	..	..	..	6	..	..
Lepidium ruderale ..	F G	91	..	18	12	..	..	8	4	Naoumoff, 90 per cent.
Lepidium campestre ..	F	26	..	16	16	..	..	18	18	Halsted, Cunningham, 39 per cent.
Lepidium virginicum ..	W	30	3	..	..	..	..	..	..	Halsted, Naoumoff, 17 per cent.
Matthiola incana ..	..	..	..	..	..	..	..	56	..	Naoumoff, 0 p.c.; Mueller and Osterwalder, 0 p.c.; Halsted 0 p.c.
Nasturtium officinale	Ditches	..	..	..	..	..	..	2	..	..
Nasturtium palustre ..	River-bed	5	..	..	..	..	..	..	..	Halsted, Naoumoff, 0 p.c.
Raphanus sativus ..	W	11	..	..	..	9	..	19	.	Halsted, Cunningham, 53 per cent.; Naoumoff.
Raphanus sp. ..	W	4	..	..	..	5	..	8	..	..
Lunaria biennis ..	G	46	12	..	..	..	..	18	18	..
Sisymbrium sophia ..	..	4	3	..	..	..	..	18	..	Hammarlund, Naoumoff, 20 per cent.
Sisymbrium orientale	G	27	..	43	4	4	4	..	..	..
Sisymbrium officinale	F W G	22	..	65	39	..	..	59	59	Naoumoff, 100 per cent.; Mueller and Osterwalder, 0 per cent.
Arabis albida ..	Cultivated	..	..	..	..	12	3	29	13	Naoumoff, 0 per cent.

* As Halsted's paper (1897) is not available, references to his list of hosts have been drawn from Naoumoff's paper of 1925.

distribution, the former in gardens in Auckland, the latter about Oamaru, and are hence comparatively unimportant. In addition to these, the crop hosts mentioned in the next sentence have been determined by dipping the roots of seedlings in a suspension of

club-root spores prior to planting in soil free from the disease. By this means swedes, turnips, thousand-headed kale, buda kale, chou moellier, mustard, cabbage, cauliflower, broccoli, and brussels sprouts have been shown to be susceptible to attacks of club-root under New Zealand conditions.

In order to ascertain whether club-root spores collected from weed hosts were capable of infecting field crops, suspensions of spores were made from tumours on *Brassica arvensis, B. campestris, B. oleracea, Diplotaxis tenuifolia, Cherianthus cheri, Lunaria biennis, Lepidium campestre, Sisymbrium orientale*, and *Arabis albida*, and distributed over rape plants growing in a glasshouse in boxes of sterilized soil. Club-root infection occurred in every case.

PRACTICAL SIGNIFICANCE OF WEED HOSTS.

Club-root spores are frequently disseminated on so-called virgin land (unstumped pasture and standing bush) by feeding out infected crops or by the infected dung of stock. Under favourable conditions weed hosts would perpetuate the organism on this type of ground, and this may offer an explanation of the apparently inexplicable infections that occur when such areas are eventually cleared and sown to swedes.

Mr. R. B. Tennent, Fields Superintendent, Dunedin, and Mr. Faithful, Instructor in Agriculture, Gore, have forwarded club-rooted specimens of shepherd's purse collected from swede crops. Infected plants of shepherd's purse have been found by the writer in an oat crop, and infected wild turnip in grass pasture. Thus the presence of susceptible weeds on infected soil will reduce the effectiveness of crop rotations on club-root control. Fortunately, susceptible weeds are not usually sufficiently numerous to maintain the heavy infection of an area, and during the course of a rotation a large number of spores will become "starved out." Where weeds are present it is probable that a few spores will be perpetuated, and that these will cause a small amount of infection on a subsequent cruciferous crop. Such infections frequently pass unnoticed, but the spores become so multiplied that a following susceptible crop is seriously attacked.

Obviously the eradication of weed hosts from pasture and oat crops is impracticable, and the presence of such weeds on a farm where club-root commonly occurs clearly indicates the impracticability of club-root eradication by "spelling" or crop rotations. Thus, where spores of the disease have survived the period of the rotation, the ability to grow a series of cruciferous crops is limited unless precautions, such as liming and the use of disease-resistant strains of seed, are taken to prevent the development of the disease.

The writer's thanks are due to the late Mr. H. Carse, of Auckland, and Mr. R. M. Laing, of Christchurch, who assisted in the collection of weed seeds, and especially to Dr. H. H. Allan, for identifying the plants from which seed was obtained and checking botanical names.

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ABNORMAL CHEESE FLAVOURS DUE TO WEEDS IN PASTURE.

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SOUND clean cheese flavour is the most important feature of a good Cheddar cheese. It is not definitely known what factors and substances in cheese give rise to desirable flavour; but it is generally recognized that unclean flavours develop when the flavour of the original milk is in any way affected. Bacterial action is the most common source of abnormal flavours. Frequently, however, there can be detected in freshly-drawn milk, feed flavours which persist after cooling, aeration, and pasteurization.

These flavours are similar to the smell of the causal foods. Dairy cattle foods in New Zealand which are known to affect the flavour of milk include (1) cruciferous crops, such as turnips, swedes, cabbages, rape, and chou moellier; (2) leguminous crops in the green state, such as lucerne, Lotus major, Lotus angustissimus, and possibly white clover while in flower; (3) green forage crops such as maize, millet, and oats and tares. Certain weeds in pastures impart a distinct flavour to milk, notably pennyroyal (*Mentha pulegium*), twin-cress, known locally as land-cress (*Coronopus didimus*), watercress species (*Nasturtium* sp.), and buttercups (*Ranunculus* sp.).

Food flavours are generally more pronounced in cream than in milk because they are absorbed by the butterfat; and they can be readily detected in butter at any time after manufacture. "Scorched" taints in butter due to this cause are often wrongly attributed to high pasteurization temperatures. They are more difficult, however, to detect in cheese after it has started to develop its flavour. They may be observed in curd and in cheese for the first fourteen days after manufacture; soon afterwards, their characteristic odours and tastes are changed by cheese flavour.

In the course of experiments at the Dairy Research Institute, unique opportunities occurred for tracing the influence on the flavour of mature cheese of abnormal flavours in milk caused by twin-cress and pennyroyal.

TWIN-CRESS FLAVOUR.

This was observed at the customary grading of experimental cheeses when fourteen days old, on eight days, at intervals in September and October, 1930. Of a total number of thirty-seven cheeses, made from four small vats of milk per day, thirty-one showed distinct evidence of cress flavour. Grazing records showed that the College herd from which the milk was drawn grazed two particular fields in either the day or the night time previous to the days on which were made the cheeses affected with the flavour.

Examination of the herbage in these fields revealed the presence of twin-cress to a limited extent in areas where the pasture sole had been slightly opened by occasional soaking with surface water. The fields in question were in first-year pasture, having been seeded to permanent pasture in the previous March, and were grazed in accordance with the accepted practice of rotational grazing, which accounts for the flavour occurring at intervals in the two months. At this time there was much luscious growth. Although the dairy herd continued to graze these fields at intervals throughout the season, no cress flavour was detected in the cheese later in the season.

The flavour was observed in the milk when the latter was delivered to the factory, on six of the eight days on which the cheese flavour was affected. It persisted after the milk had been pasteurized in a flash regenerative pasteurizer at 150° F. in accordance with standard New Zealand practice. It was noticeable in the curd during manufacture. When the cheeses were examined at fourteen days old certain of them carrying slightly high acidity exhibited the flavour to a greater degree than did those of normal acid. The abnormal flavour showed up equally distinctly in cheese from milk of high fat content as in cheese from milk of low fat content.

All of the cheeses were exported to England and were individually graded at the Wellington grading-stores when from three to four weeks old. By this time the flavour had altered to a peculiar pungent type not distinctly indicative of its source to a grader with no previous knowledge of the history of the cheese ; and, again, the full acid cheese had the more distinct and objectionable flavour. The cheeses were later examined in England, first on arrival, when three to four months old, and again two months later. The judges were given no particulars of the manufacture of the cheeses or of their previous examinations. At the first examination they described the flavours of all as " unclean," two as " bitter," four as having a " scorched " flavour, and one " herby." At the second examination a number were described as " dirty," three as " bitter," five as " scorched," and two as " metallic."

The bitter and metallic flavours are more attributable to excess acid than to the products of the original cress flavour ; but it is noteworthy that the original flavour had altered beyond easy recognition. The reference to " burnt " and " scorched " were reflections of the previous pungent and biting flavours altered by those derived from the normal ripening process. These were not attributable to pasteurization of the milk, which was carried out at a low temperature to avoid " cooked " flavours. In any case, a scorched milk flavour changes to bitterness as cheese matures.

Pennyroyal Flavour.

This was detected in each of nine cheeses made on behalf of the Institute, from two vats, in February, 1931, at a factory in the vicinity of Palmerston North. The milk used was drawn from several farms and was pasteurized at a temperature of 150° F. by an ordinary regenerative flash pasteurizer. These cheeses formed part of a series concerned with factors influencing the rate of ripening. One lot of nine was made from milk to which more rennet had been added than had been added to the other; and since the nine individual cheeses were examined after storage periods of from nine weeks to twenty-four weeks there was an opportunity of studying the influence of ripening on the original pennyroyal flavour. When graded at fourteen days, those cheeses made from milk treated with 5 oz. of rennet per 1,000 lb. showed a more distinct flavour than did those from milk to which 3 oz. of rennet per 1,000 lb. of milk were added. As the cheeses matured the distinct pennyroyal flavour gradually changed to an objectionable pungent aroma and biting taste, again due to the influence of normal flavours produced in cheese ripening.

The country from which the milk used in the manufacture of these cheeses was drawn is low-lying silt, and subject to flooding from time to time, with the result that conditions are ideal for the growth of pennyroyal, and, being relatively late in flowering, any plants in the pasture would at the time of the experiment be in flower.

Methods of dealing with Milk affected by Food Taints.

There is no known method of removing twin-cress and pennyroyal flavours from milk. Careful cooling and aeration of the milk in a clean atmosphere will help to reduce it slightly. Pasteurization of milk is also of slight benefit; but none of these methods is really effective in removing the taint. It is not practicable to remove odours from milk for cheese-making by treatment in an ordinary cream deodorizer because of changes in the constitution of the milk which make it unfit for cheese-making. The rejection of tainted milk is the only effective method of avoiding the trouble: the milk of one supplier may quite well affect the whole output of one vat of nine cheeses, and, indeed, may affect the whole factory supply coming in contact with equipment over which tainted milk has passed. Dairy factory control, therefore, depends upon the careful inspection of milk at the receiving stage before mixing it with the general milk supply. Absolute control, however, lies with the supplier, whose duty it is to keep his pasture free from these weeds.

Description of the Plants and Methods for their Control.

Twin-cress (also known as wart-cress or land-cress) is an annual found throughout New Zealand. It has slightly hairy, trailing stems which spread over the ground and may grow up to 18 in. in length. The leaves are finely divided or "cut"; the flowers are very small, inconspicuous, and may be green or white. When crushed between the fingers the plant has a strong smell.

The most characteristic feature of the plant is the fruit or pod. The pod consists of two kidney-shaped halves, joined together and supported on a slender stalk; and each half contains a seed. There may be as many as forty of these pods on one branch, and scores of branches per plant. Twin-cress flowers over a long period, and is constantly producing

seeds which drop off as they ripen. The equal division of the fruit into two halves has led to the adoption of the name twin-cress.

Twin-cress is more frequent in waste places or on bare ground than it is on permanent pasture. It is commonly found around the cowshed, in cattle-races, around gateways and similar places pugged by stock. If by reason of faulty seed, cultivation, or management the pasture is weak, and there is a lack of vigorous competition, twin-cress

FIG. 1. TWIN-CRESS (NATURAL SIZE).

FIG. 2. SHOWING SPREADING HABIT OF GROWTH OF TWIN-CRESS.

[*Photos by J. S. Yeates.*

may become a weed in pastures. In a vigorous-growing close pasture it should not feature. It is more common in young pastures than in old ones. It should be avoided in young pastures by using clean seed, and by careful cultivation. If a field is affected it may be controlled by allowing the pasture to become somewhat rank, thereby smothering the weed, or, if circumstances permit, by hoeing it out. The weed should be cleared from any waste places to which milking cows have access.

Pennyroyal is a perennial plant with a creeping root and trailing habit. The stems are much branched and square, and up to 12 in. long. The leaves are spear-head shaped and entire—that is, not " cut " as in the cress. The flowers are lilac-blue and crowded into close circular bunches at intervals along the stem. The whole plant, in common with the other members of the mint family, has a very strong odour due to the presence of aromatic oils.

Pennyroyal is found in waste places and pastures on moist land in both Islands, but is very prevalent in the northern part of the North Island, where it constitutes a menace to the dairy-farmer. It is classed on many farms as following blackberry, Californian thistle, and ragwort in importance as a weed.

When pennyroyal is prevalent over a large area it may be advisable to drain and lime the land. If the land can be ploughed, quick-growing smothering crops should be grown for one or two years prior to sowing down to grass again. Non-ploughable land should be top-dressed with

FIG. 3. PENNYROYAL (TWICE NATURAL SIZE).

lime or slag, and the field closed to stock from early spring to the end of December. The rank growth will smother out much of the weed-growth. This method is not advised except under extreme conditions of weediness. Smaller areas can be sprayed with 1–80 arsenic pentoxide solution (=1¼ lb. of the arsenic to 10 gallons of water), applied as a very fine spray at the rate of 240 gallons per acre, or with 1–40 sodium chlorate solution (=2½ lb. of the chlorate to 10 gallons of water) at the same rate of application.

Care must be taken in applying these sprays; the former is poisonous, and the latter when dry is very combustible. Precautions given by J. W. Deem, in this *Journal*, Vol. 40, page 292, and Vol. 41, page 3, should be carefully observed when using sodium chlorate.

We wish to express our thanks to Mr. W. Jacques, of the Massey Agricultural College staff, for supplying the botanical description of the plants and suggestions for methods by which to eradicate them.

TURNIP-MANURING EXPERIMENTS IN THE SOUTH ISLAND.

SUMMARY OF RESULTS FOR SEVEN SEASONS, 1924-25 TO 1930-31.

(Concluded.)

Fields Division, Department of Agriculture.

3. Comparison of Super plus Carbonate of Lime with Basic Super.

Commercial basic supers are prepared in different ways by different firms. Originally basic super was prepared by mixing 85 parts of superphosphate with 15 parts of slaked lime. Made from superphosphate containing 44 per cent. of tricalcic phosphate such a basic super would contain about 37·5 per cent. of tricalcic phosphate (equal to 17 per cent. phosphoric anhydride approximately). Such a basic super was prepared for the trials, the mixing being done at least a week, and in some cases several weeks, before sowing. It will be referred to here as "special" basic super.*

A commercial line of basic super containing 41·5 per cent. of tricalcic phosphate (= 19 per cent. of phosphoric anhydride) was obtained. The method of preparation of this material was a "trade secret." If it was a mixture of super and lime the amount of lime introduced must have been small. The phosphate content coincides very closely with what would be obtained by mixing 60 parts of super, 20 parts of Nauru phosphate, and 20 parts of lime.

Five experiments were carried out in 1929-30, comparing the following per acre treatments: (1) Super 1 cwt. plus carbonate of lime 1 cwt., (2) special basic super, 132 lb., (3) commercial basic super, 1 cwt. The super and lime, and special basic super, supplied the same amounts of phosphate per acre, but the commercial basic super supplied a little less: 119 lb. would be required to equal 1 cwt. of super in amount of phosphate. Four of the experiments were sown in 14 in. rows, the other being in 7 in. rows. The average results of these five experiments are as follow:—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
Super 1 cwt. plus carbonate of lime 1 cwt. ..	20·3	18·1
Special basic super 132 lb.	20·1	17·6
Commercial basic super 1 cwt.	20·7	16·2

The germinations did not differ significantly from one another in any of the five experiments. The yield from super plus lime was significantly better than that from special basic super in one of the five experiments only by 1·6 tons per acre. In the remainder the differences were small and not significant.

Super plus lime was significantly better than commercial basic super in four of the five experiments, the average superiority for all trials

* The method of preparing the "special" basic super was supplied by Mr. R. McGillivray, Fields Superintendent, Christchurch.

being 1·9 tons per acre. Special basic super was significantly better than commercial basic super in three of the five experiments.

The superiority of super plus lime and special basic super over the commercial basic super would seem to be greater than can be accounted for by the slight differences in amount of phosphate supplied.

NOTE.—A sample of the same line of commercial basic super, used in the 1931–32 season, was analysed and found to contain 20·4 per cent. of phosphoric acid (P_2O_5). This is about equivalent to the amount contained in super.

4. Sowing in 14 in. Rows compared with sowing in 7 in. Rows.

Where sowing on the flat is practised the most common method adopted is that of sowing through every second coulter of the drill. Sowing in 7 in. rows is, however, quite commonly practised in certain districts, especially in South Canterbury. It seemed reasonable to suppose that sowing the same amount of seed per acre through every coulter would give a more even distribution of plants over the ground; and it has been shown that halving the quantity of super per row, when straight super is used, reduces germination injury considerably. (See Section 1 (2 *a* and *b*) and (3 *a* and *b*) above.) The two methods were compared directly in six experiments. Super alone was used on only one of these and super plus carbonate of lime in five. The same amount of seed *per acre* was used as near as possible. Generally, however, it was difficult with the drills used to get exactly the same amount of seed per acre in both cases. Seeding through every coulter (7 in.) meant that the rate of sowing *per row* had to be half of that of the 14 in. rows. As a rule the seeding per acre was a little greater when sowing was done through every coulter (7 in.) than when every second coulter (14 in.) was used. The results obtained were as follows:—

(1) Using super 1 cwt. per acre in *one* experiment—8·6 oz. of seed per acre was used in sowing the 14 in. rows and 10·1 oz. in sowing the 7 in. rows, with the following results:—

	Field Germination: Plants per Area 10 ft. by 14 in.	Yield in Tons per Acre.
14 in. rows	9·0	15·3
7 in. rows	16·6	16·8
Difference	46 per cent.	1·5

The difference in rate of seeding was about 15 per cent., but the difference in germination was 46 per cent. So far as this experiment is a guide, it is better to use 7-in.-rows sowing when straight super is used. (See also Section 1 (1 *a* and *b*) and (2 *a* and *b*).)

(2) Using super 1 cwt. plus carbonate of lime 1 cwt. in five experiments, the results were:—

	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
14 in. rows	14·9	16·5
7 in. rows	19·7	17·3
Difference	24 per cent.	0·8

The difference in germination is probably due in most part to a heavier per-acre seeding in the 7 in. rows. The advantage in yield

is not very considerable and may be due in part to heavier seeding, although consideration of the effect of rate of seeding below does not lend weight to this idea. The simple expedient of sowing through every coulter rather than through every second coulter would appear justifiable, however, on those drills adapted to sowing turnips through every coulter, or where seed is mixed with the manure for sowing.

EFFECT OF INCREASING THE RATE OF SEEDING WHEN SOWING IN 7 IN. ROWS.

In the above experiments the effect of increasing the rate of seeding by 3 oz. or 4 oz. per acre when sowing in 7 in. rows was also tried, with the following results :—

(1) Using Super 1 cwt. per Acre in One Experiment.	Field Germination: Plants per Area 10 ft. by 14 in.	Yield in Tons per Acre.
10·1 oz. seed in 7 in. rows	16·6	16·8
13·5 oz. seed in 7 in. rows	22·6	17·6
Difference	27 per cent.	0·8

Increasing the number of plants has caused a small (0·8 tons) but significant increase in yield.

(2) Using Super 1 cwt. plus Carbonate of Lime 1 cwt. per Acre in Five Experiments.	Average Field Germination. Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
8·9 oz. seed in 7 in. rows	19·7	17·3
12–13 oz. seed in 7 in. rows	28·1	17·3
Difference	30 per cent.	0·0

A 30 per cent. increase in the number of plants has not had any effect on yield. The number of plants resulting from 8 oz. to 9 oz. seeding is fairly high, representing nearly two plants per square foot.

5. Methods of applying Superphosphate to reduce Germination Injury.

On land capable of responding to heavier dressings than 1 cwt. of super, methods of sowing other than those usually adopted to lessen or eliminate germination injury appeared worthy of investigation. Experiments were carried out in each of the seasons 1927–28 and 1928–29 with the object of determining the relative merits of the following: (1) Applying extra super between the rows when 14-in.-row sowing is adopted; (2) applying extra super as a predrilling (immediately before sowing seed); (3) applying extra super as a post-drilling (when plants 2 in. to 4 in. high); (4) in the case of sowing in ridges, where part of the manure is drilled below the seed and part with the seed, experiments were carried out at the Gore Experimental Area to determine the effect of varying the proportions of the super sown below and with the seed.

(1) INTER-ROW SOWING OF SUPER.

This method, whereby the manure is sown through every coulter of the drill and the seed is sown through every second coulter, ensures that only half the manure sown is in contact with the seed. Three experiments (two at Methven and one in South Canterbury)

were designed to give information on this point, the average germination and yield being shown in the following table:—

Table 2.

Treatment. (All Seed sown in 14 in. Rows.)	Average Field Germination: Plants per Area 10 ft. by 14 in.	Average Yield in Tons per Acre.
No manure	16·2	8·8
Super ½ cwt. in 14 in. rows	14·9	15·1
Super 1 cwt. in 7 in. rows	13·7	18·1
Super 1 cwt. in 14 in. rows	12·0	17·6
Super 2 cwt. in 7 in. rows	11·6	20·8
Super 2 cwt. in 14 in. rows	8·8	17·0

Comments on Table 2: The injury to germination is more or less proportionate to the amount of super sown with the seed. The yields from the manures sown wholly in the seed rows increase up to 1 cwt. per acre, but 2 cwt. per acre shows a tendency to fall off in yield. The manure sown between the rows has proved decidedly beneficial on yield. Super at 1 cwt. per acre in 7 in. rows is slightly superior to 1 cwt. in 14 in. rows; 2 cwt. of super in 7 in. rows is decidedly superior to 2 cwt. in 14 in. rows. It must be remembered that the seed was in 14 in. rows throughout.

(2) PREDRILLING SUPER.

In the three experiments mentioned above strips of super at 1 cwt. and 2 cwt. per acre respectively were drilled at right angles to the direction of the turnip rows just before sowing of the seed. Unmanured strips were left so that the effect of the predrilled manures could be compared with those sown with the seed only. The quantities of super set out in Table 2 were sown with and between the seed rows. The main features of the results were as follows:—

Predrilling 1 cwt. of super was practically as effective as applying it with the seed or part with the seed and part between the rows.

Predrilling 2 cwt. of super was practically as effective as applying 2 cwt. part with the seed and part between the rows, and distinctly better in all trials than applying the whole of 2 cwt. per acre in the seed rows.

Predrilling 1 cwt. of super caused increases over the super treatments shown in Table 2 ranging from about 2 tons to 6 tons per acre. The biggest increase occurred over the plots receiving only ½ cwt. with the seed, and the least over the plots receiving 2 cwt., in 7 in. rows. This seems a logical result, as the former gave the lowest yield when used alone and the latter gave the highest.

Predrilling 2 cwt. of super caused increases over the super treatments shown in Table 2 of 1 ton to 3 tons greater than those resulting from the predrilling of super 1 cwt. Again the increases were roughly inversely proportional to the effect of the manure drilled in at seeding. The results indicate that if a crop of turnips has been sown with manure and a bad strike results, necessitating resowing, it should not be necessary to use more than, say, ½ cwt. to 1 cwt. per acre of manure at resowing, providing of course that 1 cwt. or 2 cwt. was sown in the first instance. Further, if it is desired to use a comparatively large quantity of super with the crop, it is better to predrill or postdrill (see later) some of the super, using only ½ cwt. to 1 cwt. per acre with

the seed. In view of the benefits of using a super plus lime mixture, however, the risk to germination attending the use of straight super applied with the seed is not justified.

(3) POSTDRILLING OF SUPER.

One experiment has been conducted in the Methven district in which additional quantities of 1 cwt. and 2 cwt. of super were drilled in across the turnip rows when the plants were from 2 in. to 4 in. high. Super 1 cwt. and super 1 cwt. plus lime 1 cwt. were drilled with the seed. The yields from these two treatments applied with the seed did not differ from one another in this experiment, so need not be discussed here.

The postdrilling of 1 cwt. of super caused the yield to be increased from about 18 tons to 24 tons per acre, an increase of 6 tons per acre. The postdrilling of 2 cwt. of super resulted in a further increase over that from the 1 cwt. postdrilled of about 2½ tons per acre. It is problematical whether supplying extra super in this way is better than drilling the whole of it mixed with carbonate of lime at seeding. On land capable of responding to heavy dressing of phosphate it is certainly one way of getting good results, and the cultivation provided by the passage of the drill coulters through the ground is probably highly beneficial.

(4) VARYING THE PROPORTION OF SUPER SOWN BELOW THE SEED AND WITH THE SEED IN "RIDGE" SOWING: RESULTS AT GORE EXPERIMENTAL AREA.

The Southland practice of sowing with ridging-machines which sow in rows about 26 in. apart and have two manure-boxes and two sets of coulters, one of which deposits the manure below the seed and the other with the seed, presents a problem different from that of sowing on the flat with ordinary drills. In order to get information on methods of using manures in ridged crops experiments have been in progress at Gore Experimental Area for three seasons. Some of these results were published in this *Journal* for January, 1930(4), and November, 1931(9). The general findings of these experiments are as follows :—

(*a*) Even under the moist conditions at Gore, super sown in contact with turnip or swede seed injures germination.

(*b*) The injury which has occurred has not been reflected in appreciably reduced yields, except in the 1930–31 season. It is customary to sow a fairly heavy quantity of seed when ridging and to thin the plants to a uniform spacing later. Even with reduced germination the number of plants present allows for a good distribution of these even after thinning. No doubt this factor has lessened the loss in yield such as usually accompanies reduced germination when sowing on the flat is practised. However, as stated, in the 1930-31 season a reduction in yield accompanied a reduction in germination. Using 1½ cwt. of super with the seed and 1½ cwt. below the seed—a total of 3 cwt. per acre—caused germination to be reduced to less than half of that resulting where super plus lime was used. The yields were reduced by about 6 tons in a turnip and a swede crop respectively. 1 cwt. of super with the seed and 2 cwt. below the seed caused almost as bad results. Placing all the super—3 cwt. per acre—below the seed gave almost the same results as those from a mixture of super 3 cwt. plus lime 3 cwt., half of which was applied below and half with the seed. It is obvious from this that even under climatic conditions such as

those experienced in Southland the too free use of super alone in contact with the seed is, under some conditions, likely to be accompanied by undesirable results.

(c) At Gore, phosphates such as Ephos, Seychelles, basic slag, or a mixture of these with super, appear to give practically as good results as super. (See this *Journal* for July, 1927(5), August, 1928(6), and January, 1930(4).)

(d) The use of potash with turnips and swedes has not given outstanding results except in one or two cases. In 1928–29 an increase of about 6 tons of swedes per acre resulted from the use of 1 cwt. of 30 per cent. potash salts. In the same season a similar experiment on turnips showed no results from potash. (*Journal*, January, 1930(4).) The effect of potash on germination should be noted in the following Section 6 of this report.

(e) The use of manures in relation to club-root of turnips, swedes, and other cruciferous crops in districts where this disease is prevalent is of importance. The claims of basic slag, or a mixture of equal parts of super and freshly slaked lime, in conjunction with liming of the ground must be seriously considered. In this connection readers are referred to an article, " Control of Club-root," by J. G. Gibbs, in the *Journal* for January, 1932.

6. Effect of Nitrogenous and Potassic Fertilizers.

(1) EFFECT ON GERMINATION.

Comparatively little has been done in regard to the trial in this series of experiments of nitrogenous and potassic fertilizers. As a preliminary to the anticipated trial of these fertilizers simple trials were carried out in 1929-30 and 1930–31 to determine their effect on germination of rape and turnips, when used at 1 cwt. per acre in conjunction with super and super plus lime, in 14 in. rows on the flat. The effect of sulphate of ammonia was reported on in the *Journal* for February, 1931(7), when it was shown that the injury to germination was such as to entirely condemn the practice of sowing as much as 1 cwt. per acre with the seed. Thirty per cent. potash salts at 1 cwt. per acre had a similar effect in three trials conducted in 1930–31, only a few scattered plants surviving. Obviously smaller quantities would have a lesser effect, but it is not likely that such small quantities as would have to be used to eliminate serious injury to germination would be very effective on yield. Where potassic and soluble nitrogenous fertilizers are worth using it is obvious that they must be used in such a way as not to come in direct contact with the seed. In the case of sowing on the flat this entails predrilling, postdrilling, or broadcasting. In the case of ridging, the potassic or nitrogenous fertilizers could be sown below the seed, or broadcast before or after sowing of the crop. Representatives of potash interests recommend its application some weeks prior to the sowing of a crop.

(2) EFFECT ON YIELDS.

(a) *Potash.*—Potash has not been tried extensively on the turnip crop in experiments during recent years, but a number of experiments have been conducted at the Gore Experimental Area. The only outstanding results are the ones mentioned above in Section 5, subsection 4, and an experiment in which potash was used on chou moellier(5).

(b) *Nitrogenous Manures.*—Nitrogen in the form of dried blood at 1 cwt. per acre was used in addition to super at 1 cwt. in Canterbury

in 1924–25 and 1925–26(5). In 1924–25 it had no effect on yield, but in 1925–26 super plus dried blood registered an increase of 3⅓ tons over super alone. At Gore in 1928–29(4) 1 cwt. of dried blood increased the yield of turnips by 2 tons per acre, but had no effect on the swede crop. In 1929–31 sulphate of ammonia was used at Gore with no result on yield. In the same year sulphate of ammonia was used as a top-dressing in two trials in South Otago, 1 cwt. being applied at seeding, 1 cwt. after thinning, and 1 cwt. at seeding, plus a further 1 cwt. after thinning. The increases, although not statistically significant except in one case, resulted as follows: 1 cwt. at seeding, 1 and 4 tons approximately in the respective trials; 1 cwt. after thinning, 1 and 3 tons respectively; 1 cwt. at seeding plus 1 cwt. at thinning, approximately 5 tons increase in each case.

(3) PREDRILLING AND POSTDRILLING OF SULPHATE OF AMMONIA.

Two experiments were conducted in Canterbury to determine the effect of sulphate of ammonia at 1 cwt. per acre when drilled before seeding and after the crop was 2 in. to 4 in. high. In one of these trials there was no appreciable effect. In the other the results were as follows:—

Table 3.

Manure with Seed	No Sulphate of Ammonia.	Sulphate of Ammonia 1 cwt. predrilled.	Sulphate of Ammonia 1 cwt. postdrilled.
	Tons per Acre.	Tons per Acre.	Tons per Acre.
Super 1 cwt. plus carbonate of lime 1 cwt. ..	13·6	16·7	17·8
Super 2 cwt. plus carbonate of lime 2 cwt. ..	14·8	19·1	20·3

The increases resulting from the use of sulphate of ammonia were statistically significant, but there was no significance attached to the difference between the sulphate of ammonia predrilled and postdrilled. The indications from this trial, however, are that postdrilling is the more effective. The predrilling of sulphate of ammonia had little or no effect on germination of the crop.

ACKNOWLEDGMENTS.

The Department extends its thanks to those farmers who co-operated in these experiments. The field work in connection with the trials was carried out under the direction of Mr. R. McGillivray, Fields Superintendent, Christchurch, by Messrs. A. Y. Montgomery, W. C. Stafford, and G. G. Calder (Christchurch), E. M. Bates, (Ashburton), R. A. Calder and K. M. Montgomery (Timaru); and under the direction of Mr. R. B. Tennent, Fields Superintendent, Dunedin, by Messrs. T. Sellwood (Oamaru), A. A. Hume (Dunedin), and J. Sleeman (Experimental Area, Gore).

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—*A. W. Hudson, Crop Experimentalist.*
—*J. W. Woodcock, Assistant Crop Experimentalist.*

AN EFFECTIVE LICK-BOX FOR STOCK.

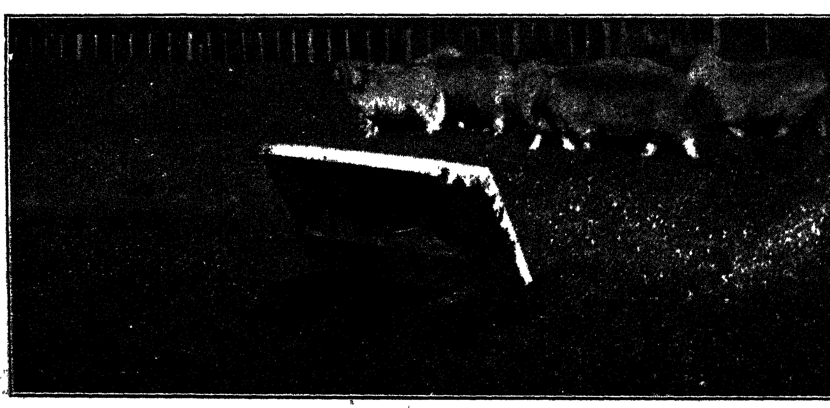
THE lick-box for sheep or cattle illustrated in the accompanying photo was developed by Mr. H. M. Besley, of Te Popo, Stratford, from a design originally used by Mr. T. Alexander, of Maxwell. It is simply and solidly constructed, practically non-capsizable, and proof against all normal weather. Nearly one hundred of these boxes have been constructed and are in use in the Te Popo district.

The base consists of two 3 ft. 4 in. by 3 in. heart rimu runners, to which are wired four 6 in. 4 in. by 3 in. heart totara blocks to prevent rotting and give easier access. The remaining timber is clean o.b. 1 in. rimu nailed together, galvanized iron nails being used wherever the lick material will come in contact. All timber is tarred to increase durability.

The measurements of the boards, so as to fit exactly, are as follows: Floor—2 ft. 5 in. by 1 ft., nailed across the centre of the runners; on this board the nail heads at each end are protected by a 3 in. by 1 in. cleat to prevent rusting and give extra strength. Sides—each, one 9 in. board, cut on a 1 ft. bevel at the upper end and an 11 in. bevel at the lower, the longest side measuring 2 ft. 3½ in. Front—a 6 in. board, bevelled to fit on the lower edge, and strengthened in the middle by a 6 in. board dividing the box. Back—two boards, one (the lower) 1 ft., and the other 9 in., each 2 ft. 7 in. long. Top—one board 2 ft. 7 in. by 1 ft.

The top, back, and part of sides are covered externally with a 3 ft. square of 24-gauge plain galvanized iron, nailed round the edges with 1 in. galvanized clouts.

The lick used by Mr. Besley for his stock is an iodized salt, bonemeal, and iron oxide mixture, with the addition of a little molasses, and is readily consumed by both sheep and cattle. In his lick trials he has kept in touch with Mr. W. M. Webster, Veterinarian, New Plymouth, and Mr. B. C. Aston, Chief Chemist, Department of Agriculture.



SEASONAL NOTES.

THE FARM.

Pre-winter Top-dressing.

IN normal years one of the weakest features of our grass-farming is the inadequate feeding of stock during winter and early spring. The current year is abnormal on account of the unusually low reserves of feed for the critical winter and spring period. Hence no means of increasing the available feed for the next few months should be overlooked.

In last month's notes it was indicated that it is exceptional if grassland does not respond profitably to phosphates, and that a farmer should make sure that his pastures belong to the exceptional non-responsive class before deciding to carry on without the assistance obtainable from appropriate top-dressing. On that very large area of land which responds profitably to phosphatic top-dressing, phosphates applied in late April or May are known to assist usefully in many districts in the provision of feed for the difficult July to September period. Hence the many farmers who have not already completed an adequate programme should endeavour to their utmost to carry out further top-dressing at the earliest opportunity, so as to obtain the advantage of whatever extra feed develops before the advent of the cold period of little or no growth. Last month the type of top-dressing that is advisable was discussed in some detail in these notes, to which reference may be made.

In recommending pre-winter top-dressing it has not been overlooked that some farmers for financial reasons may prefer spring top-dressing. Those who are forced to adopt spring top-dressing may be assured that it will be effective, but it is not likely to be as effective financially as the pre-winter top-dressing. This arises from the fundamental weakness in grassland—as a source of stock-feed it is characterized by alternate periods of oversupply and undersupply. Spring top-dressing tends to intensify this weakness, whereas pre-winter top-dressing minimizes it by giving a more even amount of feed directly available from pastures from month to month throughout the year.

As part of an extended programme, the object of which is continually increased production over a number of years, some farmers in this difficult year have more stock than at any time previously, and, as is customary in such seasons, it is impossible to dispose advantageously of what, in the circumstances, are surplus stock. As little but disappointment may be expected from increased stocking unless the larger number of stock is treated at least as well as the previous smaller number, some of our more ambitious energetic farmers are, because of the abnormal season, in a more difficult position than those who have not been planning to increase their production. Especially should those farmers who are wintering more stock than previously give thought to the assistance available from pre-winter top-dressing.

An occasional additional reason for pre-winter top-dressing lies in the fact that the application of fertilizer to broken or rolling country tends to become more difficult and costly after winter rains have made the ground soft and slippery.

Harrowing of Pastures.

The dry autumn which has been experienced in many districts has delayed progress in the grass-harrowing that is widely advisable. The farmer who omits to do such harrowing before the winter is practically sure to be

faced with the task of dealing with uneven pastures in the spring, due to patches of rank growth in the vicinity of the areas which were occupied by droppings undisturbed for any considerable time. The effective grazing of such uneven pastures is seldom accomplished unless stock are punished in forcing them to graze the rank unattractive patches.

Treatment of Young Pastures.

Particular care should be taken at this season in the handling of recently established pastures. The young plants should neither be allowed to become long nor subjected to continuous close grazing. Undergrazing is probably the more serious fault in the management of young permanent pastures, and this is certainly so if Italian rye-grass has been included in the seed mixture. Undergrazing of young pastures tends to shading, with consequent weakening and possibly destruction of certain more slowly developing valuable species. On the other hand, persistent close grazing of young pastures checks the development of the extensive root-systems which beget vigorous pastures. Young pastures are usually most effectively grazed by a relatively large number of stock for a short time only; this avoids selective hard grazing of the more attractive species which is apt to occur under light stocking. Well-controlled grazing leads to a stooling out of young plants in contrast with the drawn habit that follows undergrazing.

Liming.

When liming has been decided upon, as a rule it may be carried out suitably in April or May. If separate dressings of lime and an artificial fertilizer are to be applied to a field within a short interval it is considered preferable to distribute the lime before the fertilizer, as there is then some opportunity for the lime to become incorporated with the soil, and thereby to be able to obviate some undesirable chemical changes that may occur when fertilizer is applied in the absence of lime. If desired, superphosphate and ground limestone (carbonate) may be mixed and applied as one dressing, but superphosphate and burnt lime should not be mixed unless it is known that the mixture will be applied immediately.

With relative rapidity lime makes its way down in the soil, and tends to be washed away and lost. Hence, ordinarily, the working of lime into the soil is not only unnecessary but also disadvantageous in that it hastens the loss.

For grassland, provided transport costs are not a consideration, it is practically immaterial whether ground limestone or burnt lime is employed if these two forms of lime are on an equal cost basis, it being taken into account that approximately 2 tons of ground limestone are equivalent in their ultimate effect on the soil to 1 ton of burnt lime. This latter fact is of considerable importance when the cost of carriage of lime becomes heavy. If land is not especially in need of lime, then heavy cost of carriage may readily make the advisability of liming very questionable.

Provision of Feed Reserves.

At this period it becomes advisable to draw up the coming year's programme of special feed provision. It is quite possible that later on circumstances will call for modification of any programme drafted now, but in the meantime the programme will form the basis of decisions about such matters as cultivation work and the location of silos and fences, which should now be planned in order that labour may be devoted to them within the next few months.

Because of the abnormal season now closing, all but exceptional farms will commence the following season with reserves of feed entirely depleted. When this is the case it is most injudicious to depend for the building-up of future reserves on grass ensilage alone. There is no certainty whatever

that next summer will yield enough surplus grass growth to give reasonably safe supplies of silage, and safety in regard to supplies of the cheapest possible feed is a maxim of efficient farm-management. Hence if a farm is likely to have its current feed-reserves eliminated, then, even though extensive ensilage operations are planned for next summer, some arable cropping also should probably find a place in the coming year's programme of work.

Of seasonal interest in this connection is the fact that the mangel (which is not nearly as popular as it deserves to be) when grown after grass often gives the largest and most profitable crops as the result of May ploughing. Such ploughing allows sufficient time for the thorough decay of the buried sod and results in a more fertile soil, due partly to the rotted sod having become incorporated with it. If it is not practicable to plough at this stage, then it will be necessary in the spring to carry out either skim ploughing followed by deep ploughing, or a disking of the sod before ploughing. These alternative measures are desirable to bring about satisfactory disintegration of the sod. A buried sod if not broken up means not only a soil less rich in plant-food material, but also one in danger of drying out in the first dry spell, because such a sod checks the rise of soil-water from below it.

Autumn preparatory cultivation is also frequently advisable for carrots, potatoes, and lucerne, especially when these crops are to follow pasture. The first step should usually be skim ploughing, followed possibly by disking to break up the sod thoroughly and leave the ground in really good condition for the customary deep spring ploughing.

The Cereal Crops.

One of the most important seasonal matters relative to cereal crops is seed treatment for the control of the serious diseases which are transmitted in or on the seeds.

The best means of controlling stinking smut of wheat is dry-dusting the seed with fine copper carbonate powder. As the powder is harmful if breathed in to any extent, a suitable dust-proof mixing machine is needed for its use. Farmers not having such machines available may usually obtain supplies of treated seed from merchants. Should such treated seed not be obtainable, then the seed wheat should be pickled with formalin.

The treatment of seed oats and barley is very properly being done more generally than it was a few years ago. The copper carbonate treatment is not effective for these cereals, the seed of which requires to be treated with formalin, or seed suitably freed from disease by the hot-water treatment should be used. It is false economy to omit treating barley or oat seed on the ground that the crop will not be harvested for grain; oats infected with smut will give an inferior chaff because of loss of grain and probably also a discoloured chaff.

Serious injury of seed at times occurs on account of incorrect treatment. A description of correct methods of seed treatment was given in these notes in the March, 1930, *Journal*, and particulars may also be obtained on application to district officers of the Fields Division.

The position in regard to the manuring of cereals has been improving steadily, until much the greater portion of the total acreage of cereals is being suitably manured. On the basis of extensive experience, the use of 1 cwt. of superphosphate per acre at time of seed-sowing is recommended for wheat in the South Island. Similar manuring may be depended upon to give good results with the other cereals, which at times may respond profitably to greater amounts, particularly when bulk of green feed is a consideration.

Care of Young Stock.

As the coming winter promises to be a difficult time for much of our stock, it is well to remember that young developing animals—calves and hoggets particularly—require good attention. In New Zealand farm practice the first winter often proves the most critical period in an animal's life, because adverse influences which permanently affect its utility are so commonly operating. To avoid undue punishment, young stock should be trained to eat strange feed, particularly silage, while they are still in good condition, and before they may be called upon to subsist on such feed. Changes in feed should be carried out gradually, and if possible hoggets should be given a run-off on suitable pasture—one short and fresh—when they are being fed on special crops such as roots and chou moellier

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Autumn Spraying of Stone-fruits.

For the control of such diseases as peach leaf-curl, peach die-back, brown-rot, rust, and apricot shothole, considerable assistance can be given by the application of a fungicidal spray when the leaves are falling. It is well known that on some peaches—such as Carman, Wiggins, Elberta, and other related varieties—the application of one spray in the spring frequently fails to give good control of leaf-curl. The application of a fungicide in the autumn at leaf-fall, followed by one in the spring, is much more dependable in the control of curl on even the most susceptible varieties. In those districts growing apricots, the one spring application of a fungicide has so far not proved effective for the control of shothole on such susceptible varieties as Newcastle, and much loss is sustained through severe disfigurement of the fruit. In other countries, including South Australia and California, it appears to be the regular practice to apply a fungicide in the autumn at leaf-fall and again in the spring, with much more satisfaction than with the one spring application. Our apricot growers are therefore advised to give this treatment a trial.

The fungicide recommended for controlling disease on stone-fruits at this season of the year is bordeaux 5–4–50 (old formula), or, if hydrated lime is used, bluestone 3½ lb., hydrated lime 2 lb., water 50 gallons. Where San Jose scale is present lime-sulphur, 1 in 20 to 1 in 30, according to strength, may be substituted with good effect, although perhaps not quite so effective against leaf-curl as bordeaux.

The Orchardist's Nursery.

Most growers, especially stone-fruit growers, should have a small nursery to supply their necessary replacements. Trees may be damaged by accident beyond repair, others may be unthrifty, some may die through such diseases as silver-leaf, while others may have passed beyond the profitable stage through old age, or a variety or class of fruit may have proved unprofitable. In this and other ways in the orchards of most growers gaps appear which should be filled with young trees, while at times, also, the squaring-up of a block may require a few trees.

In practically every orchard there are one or more trees in a variety which stand above their neighbours in habit of growth, cropping, &c. If, when replacements or additions are made, the new tree is propagated from these outstanding trees, more profitable results may be anticipated and a more uniform type of fruit will be available for marketing. The planting of a few stones, the raising of a few cuttings, and the working of a few roots, together with the budding, grafting, and general attention, would not add

greatly to the work of the orchardist, and would at the same time provide a useful and profitable hobby. A portion of the vegetable garden is a convenient place for such a nursery ; a piece of ground 10 ft. wide by 20 ft. long would provide quite sufficient room for 100 trees—say, ten rows each containing ten trees.

The stock at present used for apples is the Northern Spy, but as work in connection with this is unnecessary until later in the year, advice regarding raising will be deferred to a later issue. Pears are worked on to seedling pear or quince stocks, but owing to their slow rate of growth it would probably be advisable to purchase the stocks from a nurseryman. The most popular cherry stock among New Zealand growers is the Mazzard, but as it is somewhat difficult to raise it will probably be better also to purchase these stocks. Peaches and nectarines are worked on their own seedlings. Growers do not favour the peach as a stock for apricots, some leaning to seedlings of cherry-plum, Mariana plum, or apricot, and others to cherry-plum cuttings. Plums are usually worked on cherry-plum seedlings or cuttings.

If it is intended to use seedling stocks for the apricot, peach, nectarine, or plum, the stones or " pits " should be collected immediately, before they become too hard. Petrol tins cut longways will be found convenient receptables. Place a layer of 2 in. or 3 in. of moist sand in the bottom, on this put a single layer of stones. and on top put another layer of moist sand. Put the tins away in a shady place out of doors until the spring. Do not disturb the stones, but keep the soil moist. It is wise to have considerably more pits than are actually required for working the trees, to allow for misses and the elimination of the poorer seedlings.

Where cherry-plum cuttings are desired they should be attended to now. Select shoots about the thickness of a lead pencil of this season's growth which are well ripened, discarding soft whippy growths, and cover them to prevent drying out. The soil in which they are to be planted should be in good tilth and free of weeds, the top spit having been dug over. Place a garden-line along where the row is to be planted ; along this line insert the spade into the soil at a slight angle to its full depth, raise it to the perpendicular, and withdraw it. Do this for a few feet along the line or the full length of the row. Now reduce the cuttings to about 12 in. to 15 in. long ; make a clean cut just above the top bud and just below the bottom bud. Carefully cut off the bottom three buds with a sharp knife, cutting off the bud only, without cutting into the wood, and strip off the leaves. Insert the cuttings in the spade cut about 2 in. to 3 in. apart, by pushing them down along the hard or sloping side until the bottom of the cutting reaches solid ground. When a number have been inserted walk along the row, pressing the soil solid with the heel to ensure that there is no loose soil or air-pocket against the cutting, especially at the bottom, then rake the soil level, and the operation is complete. It is advisable to get the cuttings in as soon as possible while the soil is still warm.

Where it is intended, as with pears and cherries, to purchase the stocks, the ordering should be done now. When the trees are received they should be heeled into the ground until the soil is ready, and then be planted in the nursery rows, 2 ft. between rows and 1 ft. between the trees in the rows.

Miscellaneous.

The picking and packing of apples and pears for export and local storage will still continue. Equal care should be exercised in handling fruit for the local market as for export. Where fruit is intended to be kept in home storage the building should be well ventilated, thoroughly cleansed, and, if necessary, kept cooler by sprinkling the floor with water. The stacking of such fruit should be methodical, so that the first varieties to come out can be removed with as little inconvenience as possible.

—*W. R. Lloyd Williams, Orchard Instructor, Alexandra.*

Citrus Culture.

Where fresh plantings are contemplated, every consideration should be given to some of the important features that make for success.

Shelter: Without adequate shelter it is not advisable to consider planting out citrus trees of any kind. They always come away much quicker and make more definite progress in warm sheltered positions; strong winds from any direction always have a retarding effect. Trees that come away quickly and respond to manurial and cultural treatment give a pleasure to the owner, besides assuring him of quicker returns. Unless plenty of good shelter is available, defer planting out for a while or until shelter is well established.

Soil conditions: This factor also plays a very important part in citrus culture. Only well drained land lying well to the sun should be selected. Citrus trees will thrive on various kinds of soil, providing all other conditions are satisfactory. Growers should always plan well in advance when new plantings are to be undertaken. The preliminary preparation should never be overlooked, and the soil should be worked up beforehand sufficiently long to allow it to sweeten. Land broken up out of the rough and planted is not conducive to the best results. Extra time and care in the preparation is well spent, and the owner will be well repaid when he sees the results.

Selection of trees: This is a point that should not be overlooked. Trees that are indifferent or stunted should be strictly avoided; it would be preferable to wait another season than to plant out trees that are unsatisfactory. Young healthy well-grown trees should be procured, even if the cost should appear too great. A little extra invested in this way will eventually bring its own reward.

Planting: Personally I favour spring planting in preference to autumn. However, there may be certain situations that would favour autumn planting. This can only be determined after all the facts and features of the case have been considered. One important point to bear in mind is that the soil should not be wet and stodgy at planting, but reasonably dry and friable.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

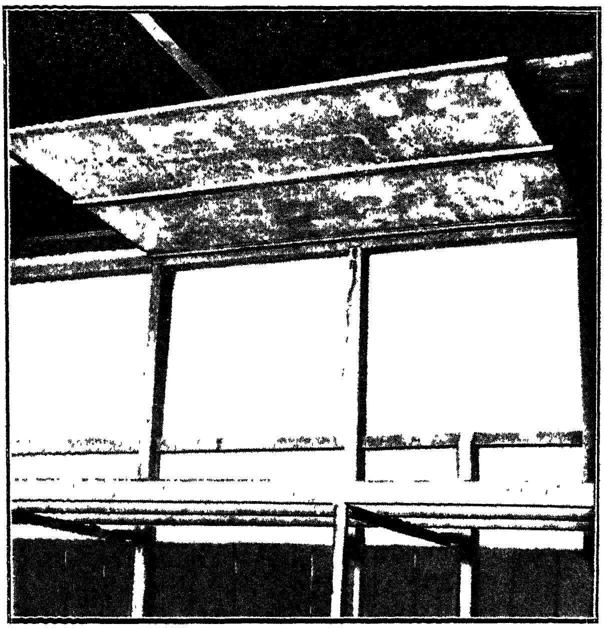
Colds and Ventilation.

It is usually during the coming months, when cold wet weather is likely to be experienced, that troubles are met with in the flock, particularly those troubles which have their origin in colds. It is important, therefore, for the poultry-keeper to be on the alert to detect the first sign of a cold making its appearance among his birds. The young birds, particularly pullets, are always more susceptible to colds than adult stock, and it is safe to say that thousands of pullets that are annually bred to lay during the winter fail to do so by reason of contracting colds, due in most cases to improper treatment on the part of their owners.

Where colds have given trouble in the past the poultry-keeper should immediately take measures to ensure that they are avoided in the future. He must first of all study his local conditions. Having provided proper housing designed on the deep open-fronted system, the next important point is to see that the houses are free from draughts and that the birds roost in comfort. This means that there should be no cracks in the side or back walls allowing a draught of air between the opening in the front of the house and the walls. In this connection probably more colds could be traced to the fact that the intersecting walls in a long building are not draught-proof than to any other single cause.

There are also many other causes responsible for fowls catching cold. Poorly ventilated quarters should be always guarded against, as in these the birds are apt to become overheated by night, making them susceptible to chill when they go out of doors. Then again, if colds are to be avoided it is imperative that the pullets should be protected from extremes of weather. A necessary factor is that the house be roomy—nothing less than 4 sq. ft. of floor space being allowed for each individual fowl. In such quarters the birds can be fed inside in wet weather and fed early in the evening, so that they will not be moping about in the rain waiting for feeding-time and going to roost with wet plumage, which obviously does not encourage the maintenance of good health and a maximum egg-yield.

Even though curative methods have been resorted to and with apparent success, the trouble is almost sure to recur at any time if the cause



THE VENTILATION SYSTEM TESTED AT WALLACEVILLE (SEE TEXT BELOW).

is not removed. While every precaution should be taken to prevent the birds from sleeping in a draught, the fact remains that an ample supply of fresh air in the sleeping quarters is imperative for their welfare. Here it may be mentioned that the amount of ventilation required in a house is a matter that can be decided only according to prevailing local conditions, and it is only by studying one's own local conditions that a safe course can be steered between too much and insufficient ventilation. For example, in some localities poultry-keepers have a ventilation space both at the back and at the front of the house, and the birds keep free from trouble, while in other localities if this principle of ventilation is adopted colds are almost sure to make their appearance.

A means allowing for ventilation space at both back and front of the modern fowl-house, without having any ill effect on the birds, has been tried at the Wallaceville Poultry Station, with a great measure of success.

An open space or spaces, according to the length of the house, is made between the top wall-plate and the roof, the ends of the space being in a direct line with the centre of, say, two or more rafters. On the latter a sheet of flat tin, beaver board, or asbestos slate is fixed, and is allowed to extend beyond the outside line of the perching arrangement. In this way a free current of fresh air passes through the space at the back wall and the opening at the top of the front of the house, and the birds are thus not compelled to sleep in a direct draught. This system of ventilation not only provides the birds with plenty of fresh air without draught, but it also greatly tends towards keeping the litter from getting into an over-wet state, which is a common occurrence during the wet winter season, and especially where the birds are overcrowded. The accompanying photo shows how easily this simple and inexpensive system of ventilation can be arranged.

Reverting to the matter of colds, when it is observed that dust and dirt are adhering to the nostrils it is a safe indication that the birds have contracted a cold, the nasal discharge causing the dust and dirt to adhere. Then follows sneezing, with a watery discharge from the eyes. When a cold has reached this stage prompt measures should be taken to stamp out the trouble, for too often the neglected cold develops into the dangerous roup. If the breath becomes offensive, and a swelling or a cheese-like substance protrudes from the eyes, it indicates that the cold has developed into roup. A cold may be treated successfully, but once the roup stage has been reached it will usually pay to destroy the bird at once rather than attempt to doctor it.

Prevention is always better than remedial treatment, but where the trouble has made its appearance treatment is, of course, necessary. Affected birds should be at once isolated, and placed in the most comfortable quarters possible. The best treatment is probably to hold the beak of the bird in kerosene in such a way that the nostrils are submerged and to keep the bird in this position until it breathes. This should effect a cure after several applications. Before treatment any adhering matter should be removed from the nostrils, while after each operation any kerosene remaining on the beak should be wiped off with a dry cloth, care being taken to see that no kerosene gets on the face, as if it does blistering will probable follow. It may be again emphasized that the poultry-keeper should take every precaution against allowing even a slight cold making its appearance by removing all sources favourable to its development. Remember that the curing of colds involves considerable labour and loss in eggs.

Feather-pulling.

Inquiries regarding fowls losing their feathers have been frequently received during recent months. In some cases this has been looked upon as an unseasonable moult. One owner states that many of his birds have been casting their feathers for months past, and have produced heavily at the same time. He asks if it is not exceptional for birds to moult and lay well. In other cases the owners have been at a loss to know the cause of their birds becoming half naked and generally presenting an unsightly appearance. It is feather-pulling, however, and nothing else. This is a bad habit and is usually the result of overcrowding, insufficient exercise, and the presence of vermin, the latter in most cases being responsible. The parasite which is chiefly responsible causes intense irritation of the skin. The fowl, in order to get rid of the irritation caused by the insects at the roots of the feathers, may pull out a feather herself, but generally invites her mates to do so.

When birds have acquired this habit it will be usually noticed first on the neck and breast of a bird, and if a male bird is in the pen he will probably be the first to be attacked. As with most other troubles that

affect poultry, the best way of dealing with feather-pulling is to prevent it by removing the cause, for if once the majority of birds in a flock acquire the habit it will prove a difficult matter to overcome. It is commonly stated that feather-pulling is due to some element required by fowls being deficient in the ration provided, and it is therefore often held that an ample supply of animal food, frequent changes of diet, or adding flowers of sulphur or salt to the morning mash, will have the desired result. It is also often recommended that if the feathers surrounding the bare patches are bathed with a bitter solution this will break the habit. I have seen all these remedies tried but with no avail. The first essential is to wage constant war on vermin by keeping the houses clean and giving them a frequent spraying with a strong disinfectant. Ample space for the birds to exercise must also be provided. Where space does not allow a good grass-run, or where the birds are being kept in the house and no outside runs are provided, the birds should be compelled to exercise by covering the floor of the house with litter in which all grains should be fed. The chief preventive, however, is to see that the birds are free from these kinds of insect pests that continually live on the body of fowls.

The best method of dealing with this class of vermin is by applying black leaf 40 (a by-product of tobacco) to the perches. From 2½ lb. to 3 lb. of this preparation will be sufficient to free a thousand birds of any lice that may be upon them. The material for this number can be effectively applied in about fifteen minutes, and the following is a good way of doing so: Make a small hole in, say, a cocoa-tin, place the liquid in it and pass it along each perch, leaving a thin line of the liquid on the perch. Do this at dusk just when the birds are going to roost. For the treatment to be really effective it is important that all birds should go or be placed on the perches, and not allowed to roost in odd corners of the house. If there is much dust on the perch the liquid is apt to run off and become wasted, and to prevent this it is a good plan to first rub the perches over with a damp cloth. If this is done the liquid can be more easily applied to the centre of the perch, and the risk of wastage will be reduced to a minimum. The treatment should be repeated in, say, ten days, after which time the birds should keep fairly free from vermin for about three months.

F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Removal of Supers.

AMONG the autumn work which must not be neglected is removal of the supers, and this should be undertaken as soon as the extracting-combs are cleaned up by the bees. It is bad management to leave the bees more space than they can occupy. By removing the supers the space in the hive is restricted, and consequently it is much easier to make the bees snug and warm for winter. Where the strength of the colony will permit this to be done, nothing is to be gained by leaving on the supers. However, it may be impossible in the case of strong colonies to confine the bees to the brood-chambers, in which case the supers can be left on the hives until the spring. By that time most of the bees will be in one story, and the supers can then be removed.

A good plan to follow in getting the bees to clean up the combs is to insert a mat, in which a small hole has been cut, between the brood-chamber and the super. The bees, finding the combs partly cut off by the mat, lose little time in removing the surplus honey. At this operation the excluders should be removed from the hives, and stored away until such time as they can be cleansed of burr combs. A little care is necessary in dealing with the excluders, so as not to bend the wires. They can be readily cleansed by plunging them into boiling water.

Winter Stores.

The losses attendant upon starvation are no less serious a menace to the beekeeper than disease. While disease is met with from time to time, each autumn brings the problem of wintering the bees, and while the professional will prepare his colonies so as to guard against serious losses, the average beekeeper is apt to overlook the essentials that make for success. There are factors such as shelter, watertight hives, vigorous young queens, &c., which all play a part in the wintering problem ; but, above all, a supply of food sufficient to meet the colonies' wants must not be overlooked. The safe wintering of bees is a test of a beekeeper's capabilities, as he is called upon to gauge the amount of stores required to tide his bees over the period between the autumn flow and the appearance of the early nectar-secreting plants. Locality plays an important part, more especially where autumn flows are unknown and fine autumn weather prevails. In these districts the consumption of stores is greater, and a constant watch must be kept on the hives so as to determine the amount of food required to guard against loss, as breeding will be carried on until a later period in the season.

Various estimates have been given as to the amount of food required to winter the cluster, varying from 30 lb. to 40 lb., and experience has proved that, providing a colony is left with this amount, it will not only winter well but will build up rapidly in the spring. In any case, it is by far the safest policy to leave an excess of food rather than run the risk of leaving the colony short and with barely enough to tide it over the dormant period. Where the amount of stores is less than 30 lb. the shortage can be made up quickly by the insertion of a few combs of honey. Calculating on the basis that a full comb contains 6 lb. of honey, it is easy to estimate the weight of honey in the hive. If, however, combs of honey are not available, feeding should be undertaken. This latter operation should not be delayed till the cold weather, but commenced early in the autumn.

For supplementing the stores, sugar syrup, fed in the proportion of two of sugar to one of water, is the best substitute for honey. Avoid using inferior qualities of sugar : none but the best white sugar should be fed. In feeding to augment the winter food supply it is often necessary to give large quantities of syrup, and consequently large feeders must be adopted. The Miller and the division-board feeders are excellent for this purpose. The former enables about 10 lb. to 25 lb. of stores to be fed at one time. It is designed to be placed inside the super or upper story on top of the brood-frames, and has two compartments for syrup, the passageway for the bees being in the centre through the bottom, directly over the cluster. The division-board feeder is popular, and enables about 5 pints of syrup to be fed. Hanging between the frames, all that is necessary is to turn back the mat so that the opening in the top is exposed. The main advantage of this feeder is that food can be supplied without exposing the cluster and without the aid of smoke.

Shelter Essential.

As in the spring, a vital necessity at this time of the year is shelter for the hives. Brood-rearing must be encouraged if the bees are to go into winter quarters sufficiently strong to give good results the following season. If a shelter-hedge or fence has not been provided an excellent temporary breakwind can be erected with manuka scrub. Shelter without too much shade is the life of an apiary, and on no account should large trees be utilized as a means for protecting the hives. The spaces between the trunks are productive of draughts, and the high branches exclude too much of the sunlight. A live hedge 8 ft. to 10 ft. high is the ideal shelter for an apiary.

Foul-brood.

The risk attendant on carrying over diseased bees is too great, as the trouble is more likely to be spread in the autumn and spring by robbing. In cases where weather conditions have prevented successful treatment, or in which disease is detected on making a final examination prior to putting the bees into winter quarters, it is advisable to remove all combs showing the slightest signs of disease. Where disease is detected in a bad form nothing will be gained by holding the colony over for treatment, and by far the safer plan is to destroy it.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Planting Bush Fruits and Passion-vines.

IN the cooler districts black currants and red, gooseberries, and raspberries flourish; but warmer temperatures are necessary for passion-vines, loganberries, tree-tomatoes, feijoa, and guava.

With the commencement of the planting season, during the month of May, most of these crops may be planted to advantage if the preparation of the land has been successfully accomplished. On no account should it be done otherwise; better is it to plant later, or even defer it for twelve months, than to set out the plants in land newly broken up and that has not sweetened, or land still infested to some extent with difficult perennial weeds. As most of these fruit crops are comparatively permanent the cultivation should be deep, and generous quantities of green cover-crops or farm manure should be turned under and given time to decay before planting is done. To avoid those extreme alternating conditions of stagnant waterlogged and dry hard soil that are so disastrous to crops, the land should be drained where they occur, and given time to improve; and, as practically all of the crops mentioned were originally inhabitants of the forests, ample shelter is beneficial and even necessary for satisfactory results.

In the richer moist loams black currants, loganberries, and raspberries thrive best. Planting at a distance of 3 ft. between plants and 6 ft. between rows will best suit most varieties of black currants grown here. Under best conditions of soil and climate loganberries are planted 9 ft. apart both ways; otherwise the spacing may be reduced a foot or so. This crop requires the support of a wire trellis or fence; 7 ft. posts, 2 ft. in the gound, 30 ft. apart, and stakes between as necessary, would be suitable. On rich land three wires fixed 2 ft., 3 ft. 6 in., and 5 ft. from the ground respectively would generally be best; otherwise two may be sufficient.

Raspberry-canes are sometimes planted in groups of three, 5 ft. to 6 ft. apart both ways; but in rather greater favour now is the method of planting single canes 1 ft. apart and 5 ft. between the rows. Low posts, with double wires about 3 ft. from the ground, keep the cropping canes in line and out of the way of cultivation.

A drier and more open position is suitable for currants, red and white, and also gooseberries; 5 ft. to 6 ft. apart both ways is suitable spacing.

The fruit of the passion-vine (*Passiflora edulis*) has now a firm place in popular estimation, and its unique qualities will no doubt ensure a lasting esteem. It has only been planted in small numbers until recently, and experience with large areas suggests some modification in methods. The best spacing under most conditions is 10 ft. between plants and 9 ft. between rows, making 480 plants to the acre. A good trellis is required for the support of the plants; that described for loganberries is suitable, except

perhaps that the top wire of the trellis may be duplicated, fixing one on each side of the top of the post. A stake should be placed at each plant so that it may be trained to the top of the trellis before branching.

The fragrant feijoa and the guava so much in demand for making jellies have not yet been grown here commercially to any extent, but they have decided possibilities in the warmer districts when care is taken to secure superior varieties. These evergreens are often recommended to be planted rather close in the row to form a cross-shelter in less exposed positions.

As previously stated, most of these crops are best planted during the month of May in well-prepared land, but loganberries and passion-vines are more often planted in the spring. Some Auckland growers advocate autumn planting for passion-vines, as the plants are not so likely to suffer from drought, but more often they are grown from seed on the spot. Spring planting is also suitable for the tree-tomato (*Cyphomandra betacea*), which specially requires good shelter from winds.

As no fruit is to be obtained from these crops during the first season, it is sometimes desirable to grow a crop in the alleys for that period. Potatoes, peas, beans, &c., may be sown, but no risk should be taken that is likely to check the development of the main crop. The pruning of the latter is best left after planting until just before growth commences.

The Tomato Crop: Insect Pests and Virus Disease.

The little grub with the grand name of *Gnorimoschema melanoplintha* did a lot of damage to the tomato crops last season, but little has been seen and less heard about it during the season just closing. The dry summer experienced in most districts was all in its favour, so it is fair to conclude that the treatment given was effective in protecting the plants, which is satisfactory so long as we do not fail to be vigilant in due season. However, if it is not one thing it is another. This season a large parcel of fruits with yellow spots that had become rather familiar on ripened fruit was carefully examined, and the condition was declared to be caused by a virus disease. Most diseases are due to fungus or bacterial organisms, but regarding the cause and nature of virus diseases comparatively little is known at present. What information is available, however, demands careful consideration if loss is to be avoided. Potato crops have long suffered from the attack of this mysterious enemy, and many other garden plants (chiefly annuals), also some weeds.

There are evidently different diseases of this class, but a common symptom is a mottled colouring of the part affected, including sometimes on leaves and fruit the yellow colours before referred to; blistered, distorted, or narrow leaves, and the ensuing stunted growth, are further symptoms. They may, of course, vary in intensity; under adverse conditions the plants may wither up and die, or under good management only one or two of the symptoms may be present, and those not very noticeable.

On the other hand, patchy ripening of the fruit and a chlorotic (light-green and yellow) colouring of the leaf may be due, as we know, to unsuitable soil-conditions or badly balanced feeding with chemical fertilizers, while a stunted condition may be due to any number of causes.

But there is one important difference in this apparent similarity of symptoms. When the symptoms are due to virus disease they are very infectious, which is not the case under other circumstances. The juice from a plant suffering from virus disease has only to be smeared on the surface of any portion of a healthy plant that is but slightly injured to transmit the trouble. Such inoculations readily take place when one is pruning, suckering, or disbudding a plant; or, what is considered one of the commonest methods, the inoculation takes place by means of sucking

insects, such as thrips or aphides. The disease can be propagated, of course, by planting infected cuttings or tubers, and in the opinion of some by taking seeds from an infected plant.

In the circumstances it is necessary to watch and study the crops carefully in order to note the first signs of trouble, and by taking prompt action much work or great losses may sometimes be avoided. In seasons when sucking insects are numerous we have now additional reasons for controlling their increase so far as possible. When pruning and tying tomato plants those that may be affected should be trimmed last, and when selecting plants for seed-bearing the first consideration should be to see that they are free from serious disease. In addition to these precautions, it is unwise to leave useless infected plants about; they should be carefully collected and burnt. Also weeds, especially those of the same natural order, should be carefully suppressed, as in many instances they also are hosts from which the virus may be transmitted.

The Vegetable Garden.

During May carrots, lettuce, cabbage, cauliflower, and broad beans are sometimes sown, chiefly in the warmer districts; and in frost-free localities peas and early potatoes are sown for harvesting in early summer.

Where new land is to be broken in an early start should be made. Besides the necessary labour it takes time to rot the sod and sweeten the soil to make it clean and fertile. More failures are due to the neglect of this precaution than to any other cause.

Trim the hedges well back to stiffen them and prevent encroachment on useful land. In wet localities see that ditches and drains are well cleaned out, so that storm-water has a ready clearance.

Where slow-acting manures are to be used on land for early planting, they may be turned in now or harrowed in after ploughing. Lime, kainit, basic slag, and blood and bone manure come under this heading. It is usually advisable to vary the diet of plants and apply potash and phosphate in different forms.

Club-root Control.

A report on the successful experiments in club-root control recently completed at the Plant Research Station, Palmerston North, was reviewed in these notes on page 143 of the February *Journal*. An inadvertent error has since been noticed in the third paragraph, where the amount of burnt lime printed as 1 oz. per square yard should have been *1 lb.*

W. C. Hyde, Horticulturist, Wellington.

Grazing of Pigs.—The fact must not be lost sight of that the pig is a natural grazer and has been provided by nature with all the facilities for grazing. In the past it has not been thought worth while to give this side of feeding much prominence on account of most farmers having a good supply of skim-milk or whey to be fed to the number of pigs they were raising. Owing, however, to the fall in prices of butter and cheese, and the decreased revenue obtained from the farm generally, many breeders and feeders of pigs are considering the advisability of increasing their pig stocks. If kept under the old system, with a proportionately lesser amount of skim-milk or whey, this would be impossible unless supplemented by bought foods. But with the addition of adequate top-dressed grass pastures, suitably divided and rotationally grazed, a much larger number of pigs may be reared and fattened with the same amount of skim-milk or whey. At the same time the animals concerned will benefit by the exercise obtained from grazing, and also by the high food-content which is always to be found in good young grass. Grazing should become a prominent feature in the future raising of our pig stocks, and this system, supplemented with dairy-products, meat-meal, and grain-meals, may be considered a sound economic practice.

WEATHER RECORDS: MARCH, 1932.

Dominion Meteorological Office.

MARCH was remarkable for the very dry weather experienced over the greater part of the Dominion, and for the prevalence of southerly or south-easterly winds. Though temperatures were on the average rather below normal, the coolness was mitigated by a comparative absence of wind. Many days were beautifully warm.

Rainfall.—Several heavy rains were experienced in the Auckland Peninsula, especially the northern portion. The totals for the month exceeded the average in all parts, but in the far North were more than double. The districts east of the main range from Hawke's Bay to East Cape also had a continuance of the wet conditions prevailing in February, and the total falls were considerably above the average. The only other area which recorded more than the normal for March was that about Dunedin. In the remainder of the country the rainfall was generally much below average. In the southern half of Taranaki, and in the Wellington, Marlborough, and Canterbury Provinces, very light falls were recorded. For example, Eltham had only 0·07 in., Foxton 0·61, Wellington 0·35, Spring Creek, Blenheim, 0·24, and Christchurch 0·48 in.

Temperature.—Though, as would be expected with southerly winds prevailing, most places had temperatures rather below the average for March, this was by no means invariably the case. In some localities, especially those protected from the direct effect of south-easterly winds, a warm month was experienced.

Sunshine.—Conditions varied somewhat, but at the majority of places there was less sunshine than normal.

Winds.—There were strong south-easterly to north-easterly winds about Cook Strait and over the North Island between the 6th and the 10th, some rather heavy gales being reported from the North, but, on the whole, winds were unusually light during the month.

Weather Systems.—The outstanding feature of the weather charts during the month was the prevalence of anticyclones over New Zealand. This was particularly noticeable at the beginning and the end of the month. Generally, the centre of high pressure was in the South, and this accounted for the frequency of south-easterly winds. The usual westerly depressions were few in number and very poorly developed.

From the 6th to the 9th, while pressure was very high to the south and south-east, a depression moved from far to the north of New Zealand in a south-south-easterly direction, past Chatham Islands. Heavy rains occurred in North Auckland and between Hawke's Bay and East Cape, many rivers being flooded.

Rains were caused in parts of the same districts between the 18th and 20th under rather similar conditions, pressure being high to the south and relatively low to the north.

Following this a cyclone gradually developed in the North Tasman Sea, while pressure remained very high to the east of New Zealand. The cyclone crossed the southern portion of the South Island on the 23rd, and northerly gales were experienced in some places. This storm was the only one during the month which produced anything approaching general rains, but on this occasion there were few localities which recorded no rain, and heavy falls occurred in most. The heaviest were in the northern and north-eastern portions of the North Island and the western and southern portions of the South Island. Some flooding again occurred.

RAINFALL FOR MARCH, 1932, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average March Rainfall.
	North Island.				
		Inches.		Inches.	Inches.
1	Kaitaia	5·50	7	2·79	2·94
2	Russell	9·98	8	2·25	2·77
3	Whangarei	9·23	9	2·94	4·23
4	Auckland	3·68	8	1·98	3·01
5	Hamilton	1·97	5	1·43	3·81
6	Rotorua	2·78	6	1·56	3·51
7	Kawhia	1·08	4	0·49	3·51
8	New Plymouth	2·11	5	1·29	3·75
9	Riversdale, Inglewood ..	3·09	5	2·70	7·12
10	Whangamomona	2·58	3	1·30	5·07
11	Eltham	0·07	1	0·07	4·05
12	Tairua	6·56	10	2·22	5·13
13	Tauranga	3·87	8	2·59	3·98
14	Maraehako Station, Opotiki	3·27	11	1·94	4·00
15	Gisborne	5·48	15	2·51	4·40
16	Taupo	1·67	5	0·88	3·19
17	Napier	4·80	12	1·77	3·16
18	Hastings	2·29	16	0·79	2·78
19	Taihape	0·51	5	0·28	2·69
20	Masterton	0·57	9	0·19	2·86
21	Patea	0·32	3	0·15	3·46
22	Wanganui	0·52	2	0·50	2·52
23	Foxton	0·61	5	0·20	2·05
24	Wellington	0·35	5	0·18	3·11
	South Island.				
25	Westport	5·33	11	2·00	7·50
26	Greymouth	2·58	5	1·28	8·91
27	Hokitika	3·99	6	2·38	9·74
28	Ross	4·01	5	1·44	11·03
29	Arthur's Pass	2·17	3	1·27	11·38
30	Okuru	2·59	6	1·18	14·70
31	Collingwood	3·12	4	1·46	5·97
32	Nelson	0·76	4	0·24	2·96
33	Spring Creek	0·24	2	0·23	2·05
35	Hanmer Springs	0·84	5	0·38	3·28
36	Highfield, Waiau	0·61	5	0·30	2·89
37	Gore Bay	0·57	4	0·25	2·23
38	Christchurch	0·48	9	0·22	1·98
39	Timaru	0·96	10	0·30	2·24
40	Lambrook Station, Fairlie ..	..	..	..	2·38
41	Benmore Station, Clearburn	0·69	2	0·57	2·78
42	Oamaru	0·70	5	0·55	1·80
43	Queenstown	0·72	2	0·64	2·64
44	Clyde	1·03	2	0·99	1·50
45	Dunedin	3·04	9	2·24	2·94
46	Wendon	2·97	6	2·22	2·73
47	Gore	..	..	..	3·25
48	Invercargill	3·25	10	1·80	3·89
49	Puysegur Point	3·88	12	1·14	8·20
50	Half-moon Bay	2·87	11	0·92	5·52

Noxious Weeds Order.—The Hawera County Council has declared gorse and Cape daisy to be noxious weeds within the county.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.

PIGS WITH LUMPS AND SWELLINGS.

M. B., Waimamaku :—

We have some sty-fed pigs about five months old, and they have developed lumps or carbuncles near their knee-joints and other parts of their bodies ; also one has an ear that looks as if it has been inflated with air, as it is thick and swollen. The pigs are fed on thick separated milk and a small amount of green stuff. Would they be fit for use if the lumps disappear ? The lumps are as large as a walnut and just under the skin.

The Live-stock Division :—

This trouble seems to me to be due to some infection or inoculation of the skin with organisms that set up the inflammation and possibly an abscess. We would hardly attribute it to the feeding, although it would be a wise thing to make a change. Allow the pigs plenty of green stuff, and add some Glauber salts to their feed once every week. A dessertspoonful per head mixed in the feed would be a suitable dose. For local treatment give them a rub over with flowers of sulphur and lard—one of sulphur to eight of lard. As hygienic measures, put the affected animals in isolation, and thoroughly disinfect the sty and flooring with formalin and water—a breakfast cup to a kerosene-tin full (4 gallons). Once they have recovered thoroughly there is no reason why they should not be fit for use.

CARRYING-CAPACITIES OF PASPALUM AND RYE-GRASS.

E. L. TANSEY, Napier :—

Can you furnish me with any data as to the comparative carrying-capacity of (1) paspalum and white clover, and (2) rye-grass and white clover pastures, on very rich alluvial flats in a district practically free from frost ? Also their comparative value for fattening, mainly sheep ? Both paspalum and rye-grass seem to do exceptionally well.

The Fields Division :—

Rye-grass and paspalum produce their maximum growth at different periods of the year, and in consequence the maximum carrying-capacity of either would vary accordingly at different periods. In your case, where both paspalum and rye-grass do exceptionally well, you are advised to establish a well-balanced mixture of the two, together with white clover. The combination, provided the pasture is well managed and utilization good, is excellent, for the reason that the paspalum by its vigorous growth during the warmest and driest weather covers the weakest period of the growth of rye-grass ; and in like manner during winter, spring, and early summer the rye-grass covers the weakest period of paspalum growth. Such a pasture should be adequately top-dressed in the autumn, which boosts the rye along through the winter and spring until the paspalum takes up the running in the warmer and drier period. Needless to say, such a mixture is ideal for fattening sheep, provided it is well controlled.

Size of Eggs important.—Too many side-line poultry-keepers fail to attach due importance to the size of eggs produced. In mating up the breeders it is especially important to know that the cockerel has come from a hen laying a good-sized egg, for however satisfactory the size of the eggs of the female are, the progeny will probably fail to maintain a good egg standard if the sire is the descendant of stock the eggs of which were of a small size. It should be remembered that the male bird influences perhaps hundreds of the progeny, whereas a hen only influences the chickens which have come from the eggs she laid.

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STOCK LICKS AND THEIR COMPOSITION.

SOME RECENT DEVELOPMENTS.

B. C. ASTON, Chief Chemist, Department of Agriculture, and J. LYONS, Director of Live-stock Division, Department of Agriculture.

IN feeding minerals to stock for the purpose of supplementing deficiencies in the natural pasture, one may be largely guided by the experience of other investigators in countries where the deficiencies are greater in degree than are found in New Zealand, and consequently where the matter has received more attention.

The Union of South Africa is perhaps foremost in the amount of careful work which has been done in experimenting on a large scale with cattle on poor country to determine the best methods of feeding minerals to the animal direct. In South Africa, it should be remarked, there is not the alternative of top-dressing the pasture with phosphates, for in that country this universal practice in New Zealand is not practicable in most deficient areas.

PHOSPHATE DEFICIENCY.

Sir Arnold Theiler and his co-workers, in exhaustive experiments to determine the cause and cure of certain puzzling troubles of stock which were gravely hindering pastoral development in the Union, had found that phosphoric acid deficiency was the main cause of a disease called "lamsiekte" (lame sickness), and pronounced so decidedly in favour of bone-meal as the form superior to all other phosphates for the cure, that one was left in no doubt as to the right phosphate to use. Bonedust was therefore adopted by the New Zealand Department as the phosphate recommended for making licks. Since then, however, Sir Arnold Theiler's collaborators (now his successors in these investigations) have looked into the matter from an economic point of view and have decided that when the artificial di-calcic phosphate (precipitated phosphate) was compared on a monetary basis with bone-meal in the relative effectiveness (1) in preventing pica (craving for unnatural food such as decaying carcasses, &c.), (2) in stimulating the growth of cattle feeding on phosphate-deficient natural food, the effective dose of bone-meal is at least twice as costly as the effective

dose of precipitated calcium phosphate. (See Du Toit and Green, 16th Report, Department of Agriculture, Union of South Africa, August, 1930, p. 267.)

The bone-meal in these experiments cost £8 per ton and the phosphate £12 10s. In New Zealand the price of bone-flour suitable for stock-feeding would be dearer than £8, while an equivalent substance supplying di-calcic phosphate would be cheaper than £12 10s. Hence the above discrepancy in the relative value of bone and precipitated phosphate would be magnified, and the cost of the latter would be cheaper in New Zealand than it would be in South Africa. Precipitated or reverted phosphate is made from superphosphate by merely dissolving it in water, filtering off the gypsum, precipitating the soluble phosphoric acid in the filtrate by the addition of lime, and separating the insoluble di-calcic phosphate from the liquid. In practice it does not seem necessary to follow all this procedure, when merely mixing the superphosphate with 15 per cent. of slaked lime will revert all the phosphate.

Another method of giving phosphate to cattle is by dissolving ordinary superphosphate in the drinking water. A trial at the Mamaku Demonstration Farm, which lasted over a year, with two cattle-beasts showed that this was a perfectly safe way of giving phosphate to stock on inferior pasture which had never been top-dressed. Both animals increased in health, and in nine months one, a young steer, was fit for the butcher.

BONE CHAR.

An alternative to bone-meal is a substance known as bone charcoal or bone char, a by-product of sugar refineries, where it is used to decolour the raw sugar. After a time and repeated calcinations the animal charcoal loses its efficacy, and is then available as a phosphate fertilizer, the phosphate content then amounting to from 72 to 82 per cent., or from 20 to 30 per cent. higher than that amount found in edible bone-meals. The Canadian Dominion Chemist, in his report for the year ending 31st March, 1930, suggests that the presence of charcoal may be useful in the animal economy by regulating or perhaps in preventing intestinal disturbances. In England spent bone char is more or less a drug on the market, and it is suggested by a writer in *Chemistry and Industry*, 12th February, 1932, p. 141, that it should be used for stock-foods, thereby reducing the necessity for introducing meals or bone-products into Great Britain. In New Zealand the Auckland sugar refinery of the Colonial Sugar Co. produces a quantity of this material, which is available for making licks.

SULPHUR.

An element in animal nutrition which has generally been neglected is sulphur, an essential mineral required in fairly large quantities by some animals, particularly sheep. There are difficulties in analysing pasture samples for total sulphur, and many old analyses are obviously too low in the sulphur figure owing to lack of precaution in preventing the volatilization of some of the sulphur when ashing the sample. Sulphur occurs in most soils largely as sulphates, a class of salts which are easily leached out of the soil. Examples of other essential elements also lost in the drainage water in large quantities are sodium and

chlorine. In lands subject to salt-laden gales rain may bring down quantities of these elements, which are abundant in sea water. Theory suggests that the drier inland and often mountainous areas might, from their more sheltered position, prove deficient in sulphur, and it is this type of country which is more generally utilized in sheep-farming. The matter is one warranting extensive investigation in view of the importance of sheep to the prosperity of this Dominion and the demand of sheep for sulphur. Low results in the sulphur content of pastures have been found in this Department's Chemical Laboratory in the case of some Marlborough and Central Otago pastures, indicating the need for including sulphur in the salt lick provided for sheep.

In the Annual Report of the South African Department of Agriculture for 1931 (p. 481) a most interesting experiment is recorded by D. J. Steyn, under the heading "The Effects of Sulphur on Merino Sheep." He concludes as follows: "Sulphur can be administered to Merino sheep at the rate of 5 grammes once, three times, or six times weekly, over prolonged periods, with striking beneficial effects on their weight and wool yield. Furthermore, it has been established that the above amounts of sulphur given throughout the course of a year have no detrimental effect on the quality of the wool, and do not cause an increase in the cystine content of the wool." He found, however, that an excess of sulphur did harm—for example, when 15 grammes of sulphur were given three times weekly sulphur-poisoning symptoms developed on the thirty-fifth day of the experiment.

From consideration of these facts, it appears possible that a small dosage of sulphur to sheep on inland situations might have very beneficial effects on both mutton and wool production at a comparatively small outlay, considering that the sulphur can be easily mixed with the salt which is, or should be, normally fed to sheep. The present market price of sulphur is about £18 per ton.

IODINE.

A great deal of propaganda regarding iodine has taken place during the last decade in an endeavour to increase the consumption of an article of which much larger quantities are available. Those interested in the matter may be referred to an interesting article on the Chilean nitrate production in the *Journal of the Society of Chemical Industry*.* The veteran Agricultural Chemist for Queensland, Mr. J. C. Bruennich, draws attention to the great variation of iodine in commercial licks sold in that State, where no deficiency in iodine has yet been established. He advises that from 8 oz. to 16 oz. of potassium iodide per ton of mixed lick seems to be quite ample. It is by no means easy to mix such a small amount as this with a ton of mixed lick, and Bruennich reports extraordinarily high results obtained on analysis in the iodine content of commercial licks—results hardly to be wondered at.

There are indications that in areas where goitres do not appear in stock, mineral iodine fed artificially by means of licks, &c., ensures a greater milk yield from cows, a decrease in temporary sterility, an

* Raw materials often contain up to one part of $NaIO_3$ (sodium iodate) in 100 parts, so that there was no reason why iodine should not be produced in large quantities, as it is easily recovered. (*Journal of Society of Chemical Industry, Vol. 36, 1917, p. 63.*)

increase in weight and wool production in sheep, as well as an improvement in the general health of the animal. None of these benefits has been definitely and scientifically established in New Zealand yet, under controlled conditions, although certain reliable cases have been reported where undoubtedly good results have been obtained.

In districts where there may be an actual deficiency of iodine in the pasture—judged by the low amount present and the occurrence of goitre in stock—beneficial results from a therapeutic use of iodine are undoubted. Cases of simple goitre in sheep have been cured and their recurrence prevented by a discriminate use of potassium iodide. The iodine content of thyroid glands of lambs born and bred on definite areas seems to give a fair indication as to the amount of iodine available in these areas. (See this *Journal* for November, 1930, page 302, and September, 1931, page 210.) Systematic advisory work on iodine feeding to stock could be based on such analytical data, but until this has been obtained, great care must be exercised in the use of iodine, as serious consequences may arise from overdosage. Large amounts of iodine fed to stock may actually do harm.

Areas in New Zealand where goitre in sheep, &c., is known to occur comprise the following: (1) Areas at foot and top of Lake Wanaka, where lambs suffer from enlarged thyroid glands; (2) various localities in Westland, and the Grey Valley and its tributaries, where lambs are similarly affected with goitre; (3) some back-country on papa formation in Poverty Bay where calves are occasionally born hairless, and where an iodine lick given to sheep greatly improves their health and development. In these areas, and no doubt in others which cannot yet be defined, possibly a higher dosage than 3 oz. of potassium iodide per ton to the lick used may be adopted; but for a general lick to include iodine 3 oz. is all that is at present warranted in normal districts.

WEIGHT OF SILAGE AT VARYING DEPTHS IN PIT.

CONSEQUENT on the test weighing of silage in a hillside silo at Stratford Demonstration Farm, Mr. J. M. Smith, Instructor in Agriculture, supplies the following data regarding the weight of a cubic foot of silage:—

Bottom	52 lb.	5 ft.	43 lb.
1 ft.	48 lb.	6 ft.	41 lb.
2 ft.	47 lb.	7 ft.	39 lb.
3 ft.	45 lb.	8 ft.	36 lb.
4 ft.	44 lb.	9 ft.	35 lb.

Average weight per cubic foot, 43 lb.

This confirms the opinion that there is a great difference between the weight of silage at the bottom of a pit (or stack) and at the top. Naturally the actual weight per cubic foot will be dependent upon several factors, the chief of which are the raw material used and the stage at which it is cut. The way the material is packed into the pit must also have some effect on the resultant weight. However, as far as grass ensilage cut at the right stage is concerned, the weight of 43 lb. per cubic foot should be a fair standard to use.

The size of the pit at Stratford Farm is diameter 20 ft. and depth 14 ft. This gives a capacity of 4,400 cubic ft., which, at the rate of 43 lb. per cubic foot, means that the pit can accommodate 84½ tons of silage.

NEW ZEALAND PASTURE SEEDS.

WHAT THE DOMINION HAS TO OFFER.

(Continued.)

E. BRUCE LEVY, Agrostologist, Plant Research Station, Department of Agriculture, Palmerston North.

(1) CERTIFIED NEW ZEALAND PERENNIAL RYE-GRASS.

This is a true perennial type localized in certain high-production areas, some of which have been under grazing for upwards of sixty years. Fields of this type are accepted for certification as mother-seed, provided they are five years old or older, pass a field inspection when in flower, and prove true to type by plot trial or ultra-violet light test. Certified New Zealand permanent-pasture rye-grass is the product of these mother-seed areas once-grown in any good seed-producing district. The fields are inspected at time of flowering, and the type is verified by trial after harvest.

The type is dense-crowned, multitillered, erect rather than prostrate, with foliage dark-green in colour; high producing, moderately early maturing, and capable of a good payable seed-crop; rather less rapid in seedling growth than ordinary commercial false perennial types,* but faster than British indigenous rye-grass. The deep green colour and the more erect habit are distinguishing features early in establishment, compared with the greyish-green, often steely-grey colour, and more flexed leaf and prostrate divaricating stem of the false perennial types.

This early colour difference noted in our broadcast plots of the true perennial type, as compared with the false perennial type, has definitely proved to be associated with differences in persistency, seasonal production, and time of flowering. The deep green, erect-leaved, tufted, and multitillered true perennial type persists and produces well, even under frequent cutting, while the lighter greyish-green colour and divaricating habit of the false perennial types is associated with lack of tillering and inability to persist either under pasture or hay, and this irrespective of the soil-type on which comparative trials have been conducted. Even on high-fertility soils the false perennial types fail to hold, being replaced by volunteers such as Poa trivialis, Yorkshire fog, New Zealand white clover, &c.

In the leaf-shoots, seed-heads, and general seed-crop the types of rye-grass show some characteristic differences. In the seedling stages the true perennial is folded in the leaf-bud and the tiller is flat-stemmed. At a similar growth-stage the false perennial usually tends to roll or at least to be less perfectly folded in the bud, and the tiller just below

* The false perennial types may be regarded as degenerate perennial rye-grass types that have lost their perennial nature, either as a result of hybridization between Italian and perennial rye-grass, or as a result of faulty methods of seed-production where maiden or first-harvest seed has been sown and reaped again and again until there has resulted only free-seeding, quick-maturing, non-persistent types of plants left in the strain, the tardy and more shy-seeding true perennial plants having gradually been eliminated. These degenerate perennials cross-fertilized with Italian rye-grass, and the resultant hybrids further crossed among themselves, have in large measure led to the deplorable state of nearly all commercial perennial rye-grass on the world markets to-day.

FIG. 2. NEW ZEALAND CERTIFIED PERENNIAL RYE-GRASS ON HIGH-FERTILITY COUNTRY, PRODUCING A DENSE-BOTTOM, WEED-FREE PASTURE. (COMPARE WITH FIG. 3.)

FIG. 3. A FALSE PERENNIAL RYE-GRASS PASTURE ON THE SAME SOIL-TYPE AND OF SAME AGE AS IN FIG. 2.

The rye-grass here has largely gone out, and white clover, Scotch thistle, docks, and Poa trivialis have taken its place. New Zealand certified seed is a safeguard against this type.

junction of blade and sheath is more or less circular in cross-section. In the period just prior to panicle production both the true and the false perennial incline towards a rolling of the leaf in the advanced tillers. The true perennial seed-stalks stand stifly erect, with but slight tendency to droop or arch in the seed-head itself. The false perennial seed-stalk is not so erect, but divergent, with a decided droop or arch of the seed-head. The true perennial is never awned; the false perennials are never strongly awned, but in a percentage of cases short awns appear, especially near the apex of the panicle and in the apical and subapical florets of some of the lower spikelets. Many of these practically

FIG. 4. A FORTY-YEAR-OLD SWARD OF NEW ZEALAND CERTIFIED PERENNIAL RYE-GRASS RUNNING UP TO A SEED-CROP.

At a little later stage than this the crop is inspected for certification purposes.

awnless, false perennial lines have been handled by merchants in the best of faith and belief that they were handling and offering true perennial rye-grass seed.

New Zealand true perennial rye-grass is less susceptible to rust than false perennial types, irrespective of origin. Rust attack seems relative to vigour. Just so soon as a type fails to maintain high vigour, and stops growing as summer approaches, it immediately becomes susceptible to rust. The more vigorous true perennial strain resists the attack until late in the season, whereas the weaker-constitutioned false perennial types cease growth early in the season and immediately fall a prey to rust. No imported line of rye-grass has resisted rust so well as New Zealand true perennial.

All the imported English, Irish, and Scottish lines of commercial perennial rye-grass failed badly after two years' broadcast trial at the

Plant Research Station. Lines from Germany, Sweden, Russia, Denmark, America, and Australia ranged from bad types to good types of false perennial. Guaranteed British indigenous old pasture rye-grass from Kent has persisted better than any other imported strain.

Table 1.—Comparison of New Zealand Rye-grass Types with Imported Commercial Perennial.

Line.	Relative Recovery after One Year.	Relative Persistency after One Year.	Relative Degree of Rust Resistance.
N.Z. true perennial	100	100	100
N.Z. false perennial	40	50	36
Imported	49	55	35

From the above data the marked superiority of the New Zealand true perennial type (certified standard) over both New Zealand false perennial and imported lines is very clear. None of the New Zealand false perennial lines are accepted for certification.

(2) Certified New Zealand White Clover.

This is an outstanding type of white clover, extremely high producing, large-leaved, long-petioled, widely spreading, with stout stolons, dense, and persistent. It establishes rapidly from seed and asserts its superiority over every other type yet tested right from the offset. It is essentially the product of the environment of the perennial high-producing pasture where any species to persist at all must necessarily be high-producing and of long seasonal growth. Certified New Zealand white clover is a comparatively good winter-growing form, is early away in the spring, and holds well into the autumn. It is essentially a dairy-pasture type, but is in New Zealand also now asserting its superiority over all other types where sown for comparative purposes on quite low-fertility soils.

In New Zealand this type normally occupies the most favoured grassland areas in both Islands, where it may occur either as a pure stand or as an important member of the sward. Plots at the trial grounds at Palmerston North sown down to this type, after two years are pure white clover swards, whereas the ordinary types have either run completely to weeds, Poa annua, and brown-top, or are at least partly overrun. The Kentish wild white clover has held moderately well, and ordinary New Zealand not quite so well as the Kentish, while the imported lots have completely run to weeds, Poa annua, and brown-top. Table 2 shows the relative production of the various types of white clover over a two-year period, and illustrates the degree of superiority of the New Zealand types Nos. 1 and 2 over all other types. New Zealand certified white clover now offering is dominantly No. 1 or No. 2, or mixtures of these two types. Up to the present New Zealand white clover has been in good demand in Great Britain, and some outstanding successes have been secured. It is more than probable that the type now being offered as certified New Zealand white clover is entirely responsible for the successes with New Zealand white clover that have been met with in the past in Great Britain. The ordinary New Zealand white clover emphatically is better than the Dutch white clover type that Great Britain uses so extensively.

It is confidently expected that the New Zealand certified type now being offered will more than hold its own with any other white clover type from any country in the world. Roughly speaking, 10 per cent. of the white clover crops produced in New Zealand are dominantly of the type now being certified. Areas producing this type are being located, and after further testing in trial plots are declared mother-seed areas. Certified New Zealand white clover—permanent-pasture standard—is derived from crops produced as a result of sowing down with certified mother-seed, or are drawn from those areas not quite pure enough to be classed as mother-seed. The mother-seed areas on the whole are old pastures, and the seed for the most part is dressed out of New Zealand true perennial rye-grass seed crops.

Hitherto, New Zealand certified crops of white clover have been based on age, and have been sold under the name "certified New Zealand old pasture." These lines on being plot-tested for type have not all come up to standard, and hence certification on age alone has been abandoned and certification on type substituted. The term "New Zealand wild white" has been used extensively in the trade and in writings of New Zealand workers. Owing to the marked superiority of the New Zealand certified strain as now recognized, and in view of New Zealand working definitely towards improved strains, it has now been decided to drop the term "wild" in connection with our certified white clover, leaving that term, because of priority, to the Kentish white clover type.

Table 2.—Relative Production of Contrasting Types of White Clover during Two Years of Trial. (Plots sown November, 1929.)

Analysis of 631 lines. New Zealand Wild White Type No. 1 = 100 at each period.

Type.	Number of Lines averaged.	Percentage of Lots of each Type in N.Z. Commercial White.	Relative Production at Dates specified.						
			4/2/30	30/7/30	16/10/30	4/12/30	23/1/31	10/3/31	29/6/31
N.Z. White No. 1 ..	37	6·3	100	100	100	100	100	100	100
N.Z. White No. 2 ..	20	3·4	95	92	89	81	81	74	60
Ordinary N.Z., plus trace N.Z. White Nos. 1 and 2	179	30·4	97	80	81	82	76	70	42
Ordinary N.Z., free of N.Z. White Nos. 1 and 2	344	58·4	87	51	64	55	45	35	13
N.Z. "Dutch" types	9	1·5	87	27	36	28	27	14	0·86
Kentish	15	..	68	55	74	63	60	50	50
Dutch imported ..	25	..	98	37	45	24	18	7·3	0·6
Ladino imported ..	2	..	100	75	68	30	51	50	Nil

(3) ORDINARY NEW ZEALAND WHITE CLOVER.

A good deal of this type will find its way on to the market outside certification. It is worth buying whenever the certified New Zealand white clover cannot be secured. Apart from a very few exceptions—less than 2 per cent. of the entire crop—ordinary New Zealand white clover is far superior to the imported Dutch types that dominate the commercial markets of Great Britain, the Continent of Europe, and America. These Dutch types, even under the mild climate of New

FIG. 5. NEW ZEALAND CERTIFIED WHITE CLOVER (ON THE RIGHT) COMPARED WITH KENTISH WILD WHITE CLOVER (LEFT) AT PLANT RESEARCH STATION TRIAL-GROUNDS.

In these trials the New Zealand certified type in every record scored considerably higher in production than the Kentish wild white (see Table 2).

FIG. 6. ORDINARY NEW ZEALAND WHITE CLOVER IN A PERMANENT PASTURE WHERE THE CLOVER CONTENT HAS BEEN KEPT UP BY PHOSPHATIC MANURING.

Ordinary New Zealand white clover does well in the field, but there is not the sustained growth as with the New Zealand certified type. Ordinary New Zealand white clover is far superior to any of the European commercial white clovers.

Zealand, are little better than annuals. Lines of ordinary New Zealand white clover may frequently contain a small percentage of good New Zealand No. 1 and No. 2 types, and when these lots are sown the presence of even quite a small percentage of the good New Zealand types in the line ultimately leads to dominance of this type under good management conditions. Plots at the Research Station area that two years ago contained just a trace of Types Nos. 1 and 2 now are becoming dominantly the No. 1 and No. 2 types, the inferior strains having gone out, leaving room for rapid spread of the few plants of the good types originally present in the line. Were it not for the fact that New Zealand is setting an exceedingly high standard for its certified seeds as far as type is concerned, virtually the whole of New Zealand white clover could be certified to as being superior to any commercial strain—excluding Kentish wild white—now on the market.

(4) KENTISH WILD WHITE.—NEW-ZEALAND-GROWN CERTIFIED KENTISH WILD WHITE.

Seed of Kentish wild white is being produced in New Zealand on as yet a small scale. The mother-seed for the sowing-down of these areas is being secured from a reliable source in Great Britain, and plot trials are conducted in New Zealand prior to or collaterally with sowings made in the field. The resultant crops from these areas are certified to as New-Zealand-grown Kentish wild white type. These crops are being produced on maiden country, so as to avoid possible contamination with our ordinary New Zealand strains. Naturally some time must elapse before New Zealand can with confidence launch out extensively in the production of Kentish wild white clover. There is just the possibility that under normal New Zealand conditions the New-Zealand-bred strains, being higher-producing, will tend to take charge of the Kentish type and thus prevent pure swards being secured here. However, there is every possibility of the Kentish wild white type doing exceedingly well on soils in New Zealand that normally do not carry much natural white clover. This refers particularly to our brown-top belt, which occupies several millions of acres of the colder, stiffish wet clays. Certainly it would be useless sowing Kentish wild white for seed-production or for any other purpose on high-fertility dairying country where the good New Zealand types are already in existence. The Kentish type would probably never get established there owing to the intense competitions that so soon arise.

Kentish wild white as a type appears excellently suited for sheep-pasture rather than cattle-pasture, and for those soils somewhat below the fertility standard for high-producing types of white clover. In other words, if the habitat range of white clover is to be extended the Kentish wild white type is more likely to effect this than any other type yet met with in the white clover type studies that have been carried out in New Zealand. Though advocating the use of a low-production strain, I feel we should impress rather the desirability of making every effort to improve soil conditions to the point that high-producing strains may thrive, rather than accept low-production strains to fit the impoverished soil conditions as they exist at the moment. As before stated, however, because we have no low-producing permanent clover, but only low-producing annuals, strain work to evolve low-production types is justified in white clover probably more so than in any other herbage species.

(To be continued.)

GERMINATING CAPACITY OF PERENNIAL RYE-GRASS SEED.

NOTES ON INVESTIGATIONAL WORK IN PROGRESS.

E. O. HYDE, Assistant Seed Analyst, Plant Research Station, Palmerston North.

SAMPLES of most of the current season's crops of perennial rye-grass seed have now been submitted for germination test, and it is apparent that, while the seed harvested in Canterbury, Hawke's Bay, and Poverty Bay is of excellent quality, much of that from the Manawatu, Otago, and Southland districts, owing to its low germinating capacity, is much inferior. Those interested in the production of certified perennial rye-grass seed in the latter districts have been greatly disappointed, and many have made inquiries of the Seed Testing Station at Palmerston North for information concerning the nature of the trouble. In view of the renewed interest in this matter, it is thought advisable to review the investigations already made and to indicate what further steps are being taken towards the solution of the problem.

The problem is not a new one, for it has been observed for some years that there occur occasionally in some districts, and more frequently in others, seasons in which the value of many crops is seriously impaired by the low germinating capacity of the seed. The following table is based on the germination percentages of all samples received by the Seed Testing Station from the main rye-grass seed producing districts during the last eight years:—

Table 1.—Average Germinating Capacity of Perennial Rye-grass Seed.

Year.	Hawke's Bay.	Sandon.	Canterbury.	Southern.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1924	93	82	91	84
1925	91	67	87	88
1926	93	81	83	74
1927	83	74	80	74
1928	68	76	74	76
1929	76	82	80	85
1930	67	48	78	72
1931	93	87	89	71

The matter first became the subject of systematic inquiry in 1923, when the crop in the Sandon district was found to be very poor. In the following years records were kept of the weather conditions at the time of flowering, and during the period of the development and harvesting of the seed. By 1927 it was apparent that seed of poor quality is produced when humid conditions predominate during the period between flowering and the ripening of the seed. (See remarks by N. R. Foy in this *Journal* for March, 1927, pages 188 and 189.)

In 1929 an experiment was planned to determine the effect on the quality of the seed of the degree of maturity at harvesting. For this purpose an area of rye-grass pasture was enclosed on the experimental area of the Department of Agriculture at Marton. The season was very wet, and the crop became rank and lodged. At the completion of the

experiment it was found that the various methods of harvesting employed produced no significant differences in the quality of the seed, which, like almost all other rye-grass seed crops produced in the district in that season, was of very low germinating capacity. It was noted with interest that seed from a strip of pasture growing under drier conditions beneath the shelter of a spreading hedge of Cupressus macrocarpa was of greatly superior quality.

Another phase of the investigations was the study of such physical properties of the seed as water content and bushel weight. No significant correlations with high or low germinating capacity were observed.

More recently attention has been turned to the examination of the caryopses or "kernels." There were observed in samples of seed of low germinating ability many caryopses distinguishable from the normal type by the following peculiarities: (1) Their opacity; (2) the roughness and reddish colour of the surface; (3) the presence of fungal hyphæ and spores on the surface of the caryopsis; (4) the presence of fungal hyphæ penetrating the pericarp, the testa, and frequently also the endosperm.

From each of a large number of samples of seed of low germinating capacity one hundred seeds were taken, and the proportion of abnormal seeds of the above type determined. The two parts of each sample were then tested for germination. The results of a number of these tests are shown in the following table:—

Table 2.—Analysis of Lots of 100 Seeds of Perennial Rye-grass.

Abnormal Seed of Type described in Text.		Remainder.	
Number.	Number germinating.	Number.	Number germinating.
61	0	39	36
90	0	10	7
16	0	84	76
34	0	66	56
32	0	68	55
48	0	52	45
44	0	56	47
29	0	71	66
27	0	73	57
47	0	53	39
86	0	14	10
88	0	12	11
20	0	80	80
23	0	77	70
51	0	49	38
26	0	74	69
78	0	22	19
61	0	39	22
16	0	84	75
70	0	30	26
32	0	68	54
40	0	60	51
55	0	45	42

It thus became apparent that none of these abnormal seeds were capable of germination, and also that in almost every sample the abnormal seeds of this type accounted for the greater part of the dead

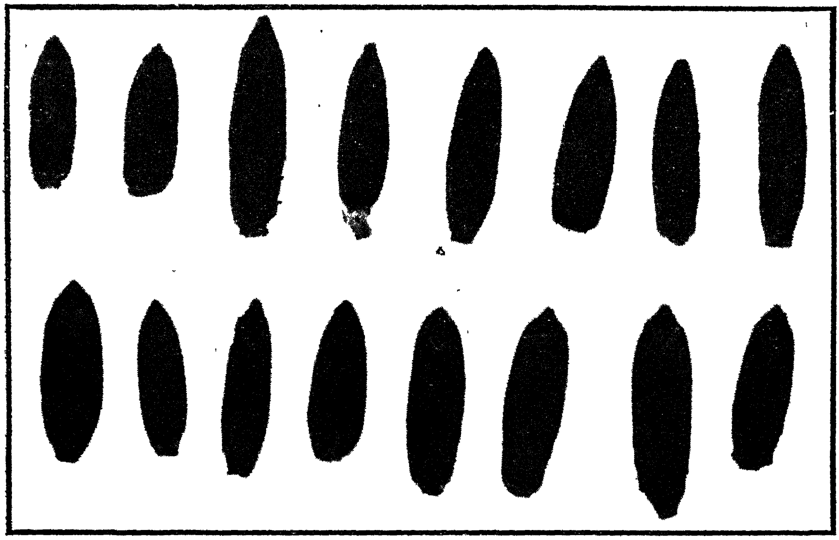

FIG. I. CARYOPSES (KERNELS) OF PERENNIAL RYE-GRASS: UPPER ROW DISEASED (NOTE THE ROUGH SURFACE AND SHRUNKEN EMBRYOS), LOWER ROW NORMAL. ENLARGED.

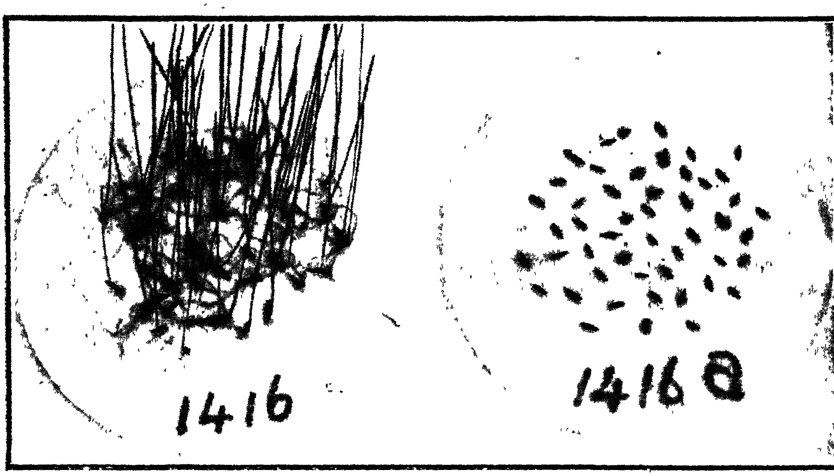

FIG. 2. PERENNIAL RYE-GRASS SEED, NORMAL (LEFT) AND DISEASED (RIGHT), PHOTOGRAPHED AFTER EIGHT DAYS UNDER CONDITIONS FAVOURABLE TO GERMINATION.

seed. Many samples of low germinating capacity and representative of the harvests of 1930, 1931, and 1932 have been examined. The foregoing examples are typical of the general conditions.

Samples of the diseased seeds have been submitted to the Plant Research Station Mycologist, Dr. G. H. Cunningham, who reports that a fungus which he is now preparing to identify has been isolated from surface-sterilized seed. Whether the fungus is parasitic and the primary cause of the death of the caryopsis, or whether it is saprophytic, only penetrating the caryopsis when this is already killed by some physiological disease, is not yet definitely known. In the present state of our knowledge it appears probable that the disease is caused by a fungal parasite, but assurance on this point depends on the results of further work being undertaken by the Mycologist.

The examination of a large number of samples has shown that perennial rye-grass in all districts is subject to the disease, and that even in an exceptionally good season the crops may not be entirely free.

Evidence is accumulating to indicate that the superior strains of perennial rye-grass are more susceptible to the disease than are inferior strains. It has been observed in several instances in different parts of Otago and Southland that while seed of comparatively high germinating capacity was harvested from fields of the local inferior strains of rye-grass, the crop from an adjacent field of certified perennial rye-grass was of very poor quality, owing to the high percentage of diseased seeds. It is worthy of note in this connection that the average germinating capacity of samples of certified perennial rye-grass seed from Southland and Otago in 1930 was 27 per cent., whereas the average germinating capacity of samples of uncertified perennial rye-grass seed from the same districts in that year was 74 per cent. Similar experience in the Sandon and Rangitikei districts where both Hawke's Bay and Southern strains of rye-grass have been sown also leads to the belief that the former strains are more susceptible to the disease.

The possibility of producing superior strains of perennial rye-grass which are less susceptible to the disease is being investigated by the Agrostologist, Mr. E. Bruce Levy.

Work is being continued along the lines indicated, and knowledge of the nature of the disease should soon be greatly extended. For the present one can only endorse Mr. Foy's conclusion that for the production of perennial rye-grass seed of good quality dry conditions during the period of development of the seed are essential. Those districts with a dry summer climate must be looked to for the production of perennial rye-grass seed of reliable quality. On the other hand, it would appear to be unwise to advocate the extensive production of certified perennial rye-grass seed in those parts of the Southland, Otago, and Manawatu districts where the summer climate is generally more humid.

It is also suggested that in districts where the weather has been unfavourable during the period of development of the seed growers would be well advised to submit to the Seed Testing Station for examination samples of seed taken shortly before the time of cutting. In this way the expenses of harvesting and dressing almost worthless crops might be avoided.

FLEECE-TESTING FOR MEDULLATED FIBRES.

THE GRADING OF ROMNEY FLEECES.

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IN an article in the March issue of this *Journal* the writer gave an account of the recent investigation into the mode of distribution of medullated fibre over the Romney fleece. It was found that this mode of distribution can be described by a very simple rule, so that the problem of fleece-sampling is thereby very much simplified. Following up this work the writer is engaged in developing on scientific lines a simple system by which it will be possible to grade Romney fleeces for breeding purposes according to their content of medullated fibres.

It is common knowledge that in recent years there has been an outcry by the English wool-manufacturing trade against an imputed deterioration in our Romney wool clip, especially with regard to the presence of hairy or strongly medullated fibres. It may be comforting to reflect that perhaps this outcry is more vehement than the actual facts warrant, but nevertheless it cannot be denied that there is very considerable room for improvement in the average standard of this wool.

The soundest way of bringing about an improvement in the quality of any breed of animals is to adopt some system whereby important inherited characteristics of individuals may be described, classified, and so recorded. For only by making it possible to *record* these characteristics in the case of individual animals can their pedigree be properly based on quality of production. Thus, to take an example, in the dairy industry the system of herd-testing, by actually measuring and recording the production of individual cows, enables the breeding of dairy cattle to be directed more accurately along profitable lines than would be possible by any less scientific means. So also in the wool-growing industry the ability to evaluate and record the inherited characteristics of the fleeces of individual stud sheep, also of flock rams, would be of inestimable value to the industry in its efforts to bring about a general improvement in our crossbred wool clip, and so retrieve and enhance its reputation on the world's markets.

Although the production of medullated fibre by a Romney sheep is undoubtedly affected by the feeding and climatic conditions in which the animal is kept, just as the output of butterfat of a dairy cow is also affected, there appears to be no escape from the conclusion that, like high-production capacity in the dairy cow, the disposition to produce medullated fibre is fundamentally controlled by inheritance. One may find badly hairy and good-woolled flocks running side by side on the same country and feed, while the same differences are even more common between the individuals of a single flock. These differences can only be differences in the hereditary make-up of the sheep themselves, and the wool research workers at Massey Agricultural College are becoming more and more convinced that the much-needed reduction in the amount of hairiness in our Romney wool clip is chiefly a matter of more careful selection and breeding. Hence any means of grading the fleeces of Romney rams and breeding-ewes, particularly in the stud flocks, according to their content of medullated fibre is bound to be of value.

It is obviously very important to know as precisely as possible in what way different types of climate, country, and feed affect the production of medullated fibre by those animals that have inherited a distinct tendency towards this defect. Several observations and small-scale experiments have already been made in this connection, but insufficient data have yet accumulated to warrant any statement of results and conclusions. A commencement, however, of fleece-testing experiments on a large scale was made during the past spring on 160 animals from three different flocks. It is hoped that it will be possible to continue examining these and other animals and their progeny for a number of years in order that a careful study may be made of the following points :—

(1) Development and simplification of the technique of flock-testing.

(2) Accumulation of further data on the mode of distribution of medullated fibre over the Romney fleece. This is needed to confirm the very encouraging results already obtained from the study of a small number of animals.

(3) The relation between the first, second, and third, &c., fleeces of Romney sheep in regard to medullation.

(4) Inheritance of the disposition to produce medullated fibre. Large-scale breeding experiments in which the fleeces of parents and progeny are graded according to their content of medullated fibre will throw much light on the manner in which the tendency to produce medullated fibre may be inherited and passed on to succeeding generations.

(5) Influence of climate, country, and feed. By testing the successive fleeces of small numbers of sheep that are transferred from one type of country or feed to another, the various effects of climate, country, and feed on the production of medullated fibre will, it is anticipated, be definitely ascertained.

(6) By studying the constitution of the sheep in relation to the nature of their fleeces, it is hoped to throw much light on the vexed question of whether or not it is possible to maintain a vigorous constitution and completely eliminate medullated fibre from the fleece at the same time.

The study of all these important and ever recurrent questions is made possible by the development of a means of grading fleeces according to their degrees of medullation, so that in this respect the individual fleece quality of large number of animals may be accurately ascertained and recorded.

The following notes indicate the developments that have been made in the technique of fleece-testing. A card-index system of filing the records of all fleeces tested is being put into operation. This will form the nucleus of a system whereby the pedigree of rams and valuable breeding-ewes may be more accurately based on quality of wool production than has been possible in the past.

The Technique of Fleece-testing.

It is obvious that if the grading of fleeces is to be of practical value it must be possible to carry out the necessary fleece examination in the minimum amount of time, and careful attention has consequently been given to the development of a suitable technique for sampling. The problems faced in this connection are twofold. Firstly, there is the question of the number and position of the staples to be selected as a fleece sample; secondly, there is the evolution of the method by which these samples may be selected, labelled, and packed most expeditiously.

Dealing first of all with the selection of the samples for test, the reader is referred to the previous article in the March issue of the *Journal*, wherein it is shown that according to all present available data medullation disposes itself over the Romney fleece according to a simple rule. Based on this rule provisional recommendations were made as a guide to breeders in the testing of their own rams and ewes by means of the benzol test.

It must now be pointed out that the number of staples required as a sample of a fleece depends on the purpose for which the fleece-testing is being carried out. For the purpose of the large-scale experiments outlined above, where comparatively small numbers of fleeces, subject to a variety of carefully observed feeding and climatic influences, have to be compared, as accurate an evaluation as possible of each fleece is required, in order that the results can be dealt with mathematically, and the relative importance of the various influences ascertained. In such cases the data so far obtained have shown that the three fleece areas—shoulder, side, and britch—(as defined on page 195 of the March *Journal*) on one side of the animal must be sampled, and a sufficient number of staples taken from each area to provide a properly representative sample.

An investigation has been carried out with a view to finding the number of staples that are necessary for this purpose. Each fleece area of each of the three two-tooth ewe fleeces was repeatedly sampled, sometimes three times, sometimes four times, taking either six or twelve staples per sample. These samples were tested by the benzol test, and the degree of medullation of each staple evaluated out of a maximum of 300. The results are summarized in the accompanying table.

Studied mathematically, these figures show that for the six staple samples the mean coefficient of variation is 20·1 per cent., while for the twelve staple samples it is 11·1 per cent. Translated into non-technical language, this means that the error involved in relying on six staple samples is nearly twice as much as when twelve staples per sample are taken, and that, on the average, samples of six staples per fleece area are liable to be inaccurate to the extent of either 20 per cent. too high or too low. However, considering the very great range in degrees of medullation encountered, the writer is inclined to the opinion that *for experimental purposes*, when more than a few sheep are being dealt with, samples of six staples per fleece area (*i.e.*, eighteen staples per fleece) will in most cases be sufficient. We may for convenience speak of this mode of sampling as "experimental sampling," in order to distinguish it from the less detailed sampling which would be carried out by a breeder in examining his own sheep.

Fleece Grading for Breeding Purposes.

Turning now to the systematic grading of fleeces for breeding purposes, judging from the results of the fleece examinations already made, it appears highly probable that it will be possible to grade fleeces simply according to the extent to which the medullation has spread forward along the side of the animal. In this case the selection of samples would be very much simplified. The question as to whether or not this is a sufficiently reliable method of judging the degree of medullation of a fleece will, it is anticipated, be decided as one of the results of the large-scale fleece-testing investigation now in hand.

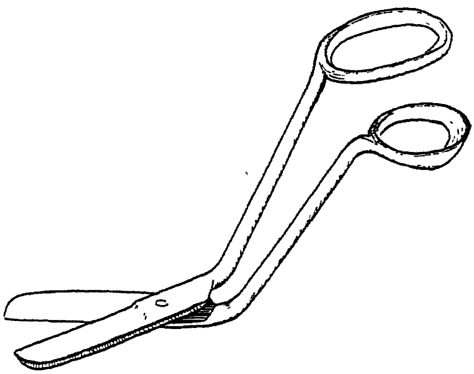
Results of repeated Sampling of Three Romney Two-tooth Ewe Fleeces.

Fleece Areas	Right Shoulder.	Left Shoulder.	Right Side.	Left Side.	Right Britch.	Left Britch.	Neck.	Back.	Rump.
				Fleece 1.					
Number of staples per sample	6	6	6	6	6	6	6	6	6
Average test of each sample	0·8 0·3 0·2	1·3 0·3	34 30 15	20 26 41 32	59 86 73 57	75 95 80 82	0 0 0 0	1 Tr.* 1 Tr.*	17 33 23 33
Average of all samples	0·4	0·8	26	30	69	83	0	0·5	26
				Fleece 2.					
Number of staples per sample	12	12	12	12	12	12	12	12	12
Average test of each sample	15 14 18	15 5 10	56 46 52	52 49 49	101 100 102	89 80 72	0 0·3 0·3	10 11 12	43 43 49
Average of all samples	15·7	10·0	51·3	50·0	101·0	80·3	0·2	11·0	45·0
				Fleece 3.					
Number of staples per sample	12	6	12	6	12	6	12	12	12
Average test of each sample	56 57 57	61 38 59	89 83 122	105 113 107	101 101 105	89 78 102	25 29 25	70 75 66	78 73 63
Average of all samples	56·7	52·7	98·1	108·3	102·3	89·7	26·3	70·3	71·3

* Tr. = trace of medulla.

NOTE.—Each fleece area was repeatedly sampled either three or four times, a sample comprising sometimes six, sometimes twelve staples The degree of medullation of each staple was evaluated with the aid of the benzol test out of a maximum of 300 (*i.e.*, 0 = all pure wool, 300 = all hair). The "Average test of each sample" represents the average of the values thus assigned to each of the six or twelve staples comprising the sample; while the "Average of all samples" represents as nearly as is known the true average value for each fleece area It is considered, taking into account the wide range of values encountered, that the six staple samples agree sufficiently well among themselves for the purpose of large-scale "experimental sampling" of fleeces.

In selecting staples for test, if the proportion of medullated fibre in the staple is required, it is important that the whole of the staple should be obtained. Therefore the staples should not be pulled out, but cut off as near the skin as possible. When large numbers of samples have to be taken, ordinary scissors are not convenient for this purpose, and a special pair of scissors with the blades and handles bent at about sixty degrees to the shafts has been found very convenient for the purpose.



SPECIAL SCISSORS USED FOR FLEECE-SAMPLING.

When, as in the case of "experimental sampling," very large numbers of staples have to be taken at one time, it is often inconvenient and always wasteful of time to test them as they are cut. A simple method has therefore been developed whereby the staples may each be labelled and packed for transport or storage with great rapidity. The staples, as they are cut, are placed between the leaves of a small "sample book," made of stapling together a suitable number of sheets of paper 8 in. by 5 in. Each leaf is marked with the number or position of the staple, and when filled the book is rolled up, tied with string, and labelled with particulars of the animal and fleece area from which the staples are taken. Samples are thus rapidly and conveniently secured for transport and storage.

By adopting these developments in technique staples can be selected from definite positions in the fleece, cut, and each labelled and packed separately, by two workers at the rate of four to five staples per minute, taking into account also the time spent in handling the sheep. Thus, for example, 900 staples were recently selected for experimental purposes from the fleeces of fifty hoggets in the space of three hours twenty minutes. Thus it will be seen that it is rapidly becoming possible and practicable to grade the fleeces of the more valuable Romney rams and ewes scientifically, according to their content of medullated fibres.

In conclusion, the writer wishes to emphasize what he considers to be the outstanding value to the wool-growing industry of this new means of grading individual fleeces according to one of their most important qualities—namely, that it enables that quality to be *recorded*, so that the pedigree of breeding-stock can be more accurately based on quality of production.

PASTURE TOP-DRESSING TRIALS IN OTAGO.

SUMMARY OF RESULTS FOR SEASONS 1927, 1928, AND 1929.

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IN 1927 a number of top-dressing trials were laid down on pastures in various parts of Otago, with the object of endeavouring to ascertain the effect of top-dressing in the production of hay. An effort was also made to determine the lasting effect of certain fertilizers by carrying out observations and weighings over a period of three years from the time of the original and only top-dressing given to the plots. Two years' results in regard to these trials have already been published in the *Journal*, and it is not intended in this summary to treat extensively individual experiments, as it is felt that a review on broad lines regarding the effect of the various fertilizers under trial will prove of greater general application than the publication of a mass of detail on individual results. This summary, therefore, covers thirty-eight experiments.

PLAN OF THE EXPERIMENTS.

Various types of pastures throughout Otago were selected for top-dressing trials. In arranging the scope of the experiment a uniform plan was adhered to throughout, the drill-strip method of replicated plots being employed in applying the fertilizers, thus allowing all results to be statistically examined. The objects of the experiments were comparatively simple, being to test the efficiency of phosphates both alone and in conjunction with carbonate of lime, and, further, to acquire definite information as to the value of applications of lime alone on pasture.

The phosphates under trial were superphosphate, 44–46 per cent. tricalcic phosphate, equal to a minimum of 20·2 per cent. phosphoric acid (44–46 per cent. grade), and basic slag (Trifolium brand, 17–20 per cent. phosphoric acid grade). These manures were applied at the rate of 3 cwt. per acre (with three exceptions), and cross-dressings of carbonate of lime in a finely ground condition were applied at the rate of 1 ton per acre. The plots were dressed during the months of July, August, and September, 1927. At an appropriate season they were shut for hay, and hay weights were eventually taken.

On account of the large number of plots to be examined, it was practically impossible to harvest each at its peak of production ; consequently, it will be noticed that those experiments carried out on high-class land sometimes show comparatively low weighings when compared with those on poorer soil-types. Again, seasonal differences in the various localities wherein the plots are situated account for variations in total production. The yields, therefore, given throughout in no way represent the relative fertility of the different plots.

PASTURE TYPES.

As the experiments progressed, it became increasingly apparent that the main factor in the effectiveness of a fertilizer was the pasture type, with its various associations of grasses and clovers. The presence

of a good amount of red clover, for instance, invariably resulted in increased general growth when the plot was dressed with phosphates, resulting in that experiment giving large increases over the unmanured or control plots, whereas pastures practically devoid of clover gave little response to dressings of phosphate. Quick-growing rye-grass, white clover, and red clover associations invariably responded more vigorously to top-dressing than less productive and slower-growing pasture types.

For the purpose of this summary it has been found advisable, therefore, to classify the types of pasture upon which the experiments have been carried out into four main groups designated types A, B, C, and D. Although no hard-and-fast definition can be laid down for each type, owing to the mergence of characteristics, the following arbitrary description in the main covers the classification of the various pastures under experiment :—

Type A : Young grass, vigorous growing, predominantly constituted of rye-grass, red clover, and white clover. Sole close, but not sod-bound. High-production pasture.

Type B : Dominantly rye-grass and white clover, with practically no red or alsike clover. Admixed with cocksfoot, dogstail, and other grasses. Sown down for a considerable time. Not so vigorous as type A. Dense sole, good producing pasture.

Type C : Dominantly cocksfoot, dogstail, and grasses other than rye-grass, which latter is present only in negligible quantities. Practically no white clover. Usually strong suckling clover. Close sole. Moderate production, inferior to types A and B.

Type D : Dominantly brown-top (*Agrostis tenuis*), with minimum of clover growth and practically no rye-grass Dense matted sole, often admixed with dogstail and sweet vernal. Low production and inferior to types A, B, and C.

In regard to these pasture types, it can be conceded that the type is a direct indicator of the fertility of the soil upon which it is growing. Thus type A pastures represent soils of high fertility, and type D soils of low fertility.

Measurement of Results.

It is fully realized that the effects of various fertilizers on pastures are manifold, such factors as palatability, swarding, and changes in plant associations being intimately bound up with increased production where such takes place. These effects, however, are difficult to determine and record, although in many cases they are quite noticeable. The main factor of increased production, however, does lend itself to the measurement, and even although this factor is difficult to estimate in its entirety, it can be taken as a fairly reliable comparative index of the effect of the various top-dressing materials used in an experiment. Therefore the gauge utilized in estimating the effect of the various fertilizers in this series of experiments was the hay weight produced on the treated plots as compared with the hay produced on the control or unmanured plots. No consideration is here taken as to the effects of early production and the aftermath, so that it must be realized that the production figures given in no way represent the total production or represent the complete effects obtained by the application of the various manures.

Experiments on Type A Pastures.

Six trials on type A pastures were carried out, and of these five were shut up for hay and harvested for three years in succession. In

the case of the trial on the property of Mr. R. G. Borrie, of Papakaio, this was only harvested during two successive seasons. Details of each year's yield and the total yield over the seasons during which the trials were harvested are given in the following table:—

Table 1.—Results of Hay Manurial Trials on Type A Pastures.

Farmer's Name.	Yield in Tons of Hay per Acre.					
	Control.	Super.	Slag.	Lime.	Super plus Lime.	Slag plus Lime.
			First Year.			
D. Smollett, Awamangu	1·70	1·75	2·56	1·80	1·82	2·61
R. G. Borrie, Papakaio	0·62	1·30	0·72	0·77	1·51	0·80
R Kinnard, Maungatua	1·76	2·38	2·26	2·03	2·52	2·26
Mrs. Manson, Enfield ..	0·75	1·61	0·85	0·76	1·52	0·86
A. Tweed, Moneymore	1·15	1·48	1·47	1·23	1·52	1·47
J. Williamson, Bortons	0·37	2·20	0·51	0·48	2·17	0·60
			Second Year.			
D. Smollett, Awamangu	2·80	3·01	3·52	3·23	3·11	3·61
R. G. Borrie, Papakaio	0·50	0·55	0·50	0·52	0·55	0·52
R. Kinnard, Maungatua	2·95	3·40	3·20	3·20	3·70	3·60
Mrs. Manson, Enfield ..	1·15	1·30	1·22	1·15	1·32	1·20
A. Tweed, Moneymore ..	1·72	1·85	1·72	1·70	1·85	1·72
J. Williamson, Bortons	0·20	0·32	0·22	0·15	0·30	0·20
			Third Year.			
D. Smollett, Awamangu	1·80	1·85	2·10	2·00	2·05	2·25
R. G. Borrie, Papakaio*	..	..	..	..	..	..
R. Kinnard, Maungatua	2·10	2·35	2·25	2·25	2·40	2·30
Mrs. Manson, Enfield ..	1·10	1·22	1·22	1·12	1·22	1·15
A. Tweed, Moneymore ..	1·82	1·85	1·85	2·00	2·00	2·00
J. Williamson, Bortons	0·62	0·82	0·65	0·60	0·72	0·62
			Total Yield for Three Seasons.			
D. Smollett, Awamangu	6·30	6·61	8·22	7·13	7·98	8·47
R. G. Borrie, Papakaio	1·12	1·85	1·22	1·30	2·06	1·32
R. Kinnard, Maungatua	6·81	8·18	7·81	7·58	8·62	8·16
Mrs. Manson, Enfield ..	3·00	4·13	3·20	3·03	4·07	3·21
A. Tweed, Moneymore	4·70	5·18	5·05	4·93	5·37	5·20
J. Williamson, Bortons	1·20	3·35	1·38	1·23	3·20	1·83

* Area not harvested.

Remarks on Table 1: Taking individual results, it will be observed that where superphosphate plus lime was applied, in the case of five experiments this mixture gave the highest yield. In the case of the trial on D. Smollett's farm at Awamangu, basic slag plus lime gave a higher aggregate yield than super plus lime. The results obtained from super and super plus lime on the remaining five trials were much more striking than those obtained from slag alone or slag in conjunction with lime. This confirms the general observation that on the average type A pasture superphosphate either alone or in combination with lime can be relied upon to give excellent results. It is to be noted that the greatest increases were obtained during the first year when the fertilizers were applied. Further, although the general hay production was higher during the second year on account of seasonal

effects, a considerable levelling down occurred in regard to the plots receiving fertilizer. During the third season very little differences from the variously treated plots were observed. It has also to be recorded that where increases in weights were obtained, such increases were invariably due to the growth of clover, the grasses being stimulated only to a comparatively small extent. The effect of lime top-dressed alone, while apparent, was not marked.

The following table summarizes the results obtained on type A pastures, giving the average yield from the different treatments during the first, second, and third harvest years; also the average annual yield of hay.

Table 2.—Summary of Results of Hay Manurial Trials on Type A Pastures.

Treatment.	Yield in Tons per Acre.							
	First Year.		Second Year.		Third Year.		Average Annual	
	Average of Six Trials.	Relative Yields.	Average of Six Trials.	Relative Yields.	Average of Five Trials.	Relative Yields.	Yield of Hay.	Relative Yields.
Control ..	1·06	100	1·55	100	1·48	100	1·36	100
Super ..	1·78	168	1·73	112	1·61	109	1·70	125
Slag ..	1·39	131	1·73	112	1·61	109	1·57	115
Lime ..	1·17	110	1·66	107	1·59	107	1·47	108
Super and lime	1·85	175	1·80	116	1·68	114	1·77	130
Slag and lime	1·43	135	1·80	116	1·66	112	1·61	118

Experiments on Type B Pastures.

In the case of the nine trials laid down on pastures of type B, six were continued for the full three years, two for two years, and one was harvested only during the first season. The results of these trials are shown in Table 3.

Remarks on Table 3: As is to be expected, the average general production from type B pastures is lower than that obtained on type A pastures, on account of their greater age and less vigorous nature. During the first and second years the results obtained from superphosphate alone and in combination with lime were greatly superior

Table 3.—Results of Hay Manurial Trials on Type B Pastures.

Farmer's Name.	Yield in Tons of Hay per Acre.					
	Control.	Super.	Slag.	Lime.	Super plus Lime.	Slag plus Lime.
			First Year.			
J. Crutchley, Kyeburn	0·55	1·95	0·63	0·56	2·08	0·67
S. G. Greer, Patearoa ..	1·87	2·66	2·12	1·80	2·80	2·28
A. C. Hurst, Windsor ..	1·07	1·48	1·20	1·15	1·38	1·25
W. Lusk, Crookston ..	1·13	1·32	1·13	1·08	1·31	1·07
W. McMillan, Herbert ..	0·97	1·25	1·08	1·17	1·28	1·26
I. Revie, Crookston ..	1·42	1·81	1·53	1·38	1·80	1·41
J. Roberts, Middlemarch	0·52	1·21	0·65	0·71	1·16	0·73
D. McG. Reid, Milton ..	1·10	1·58	1·38	1·31	1·88	1·80
H. S. Sheat, Bushey ..	1·46	1·90	1·65	1·62	2·02	1·71

Table 3—continued.

Farmer's Name.	Yield in Tons of Hay per Acre.					
	Control.	Super.	Slag.	Lime.	Super plus Lime.	Slag plus Lime.
	Second Year.					
J. Crutchley, Kyeburn	0·60	1·00	0·62	0·60	0·95	0·65
S. G. Greer, Patearoa ..	1·50	2·10	1·72	1·42	2·00	1·55
A. C. Hurst, Windsor*	..	..	..	..	..	..
W. Lusk, Crookston ..	1·80	2·31	2·11	1·80	2·01	1·83
W. McMillan, Herbert ..	1·10	1·15	1·12	1·02	1·20	1·10
I. Revie, Crookston ..	0·92	1·50	1·27	0·96	1·42	1·01
J. Roberts, Middlemarch	0·80	0·85	0·82	0·71	0·71	0·75
D. McG. Reid, Milton ..	1·22	1·45	1·42	1·35	1·62	1·55
H. S. Sheat, Bushey ..	0·55	0·95	0·60	0·60	0·70	0·62
	Third Year.					
J. Crutchley, Kyeburn	0·70	0·82	0·70	0·70	0·80	0·72
S. G. Greer, Patearoa ..	1·75	2·15	1·95	1·70	2·12	1·82
A. C. Hurst, Windsor*	..	..	..	..	..	..
W. Lusk, Crookston ..	1·70	2·02	1·95	1·72	2·00	1·90
W. McMillan, Herbert ..	0·70	0·80	0·72	0·75	0·85	0·80
I. Revie, Crookston* ..	..	..	..	..	..	..
J. Roberts, Middlemarch*	..	..	..	..	..	..
D. McG. Reid, Milton ..	1·30	1·42	1·40	1·52	1·52	1·60
H. S. Sheat, Bushey ..	0·92	1·00	0·92	0·92	0·92	0·95
	Total Yield for Three Seasons.					
J. Crutchley, Kyeburn	1·85	3·77	1·96	1·86	3·83	2·05
S. G. Greer, Patearoa ..	5·12	6·91	5·80	4·92	6·92	5·66
A. C. Hurst, Windsor ..	1·07	1·48	1·20	1·15	1·38	1·25
W. Lusk, Crookston ..	3·63	5·65	5·19	4·60	5·32	4·80
W. McMillan, Herbert ..	2·77	3·20	2·93	2·95	3·32	3·16
I. Revie, Crookston ..	2·34	3·31	2·80	2·34	3·22	2·42
J. Roberts, Middlemarch	1·32	2·06	1·47	1·42	1·87	1·48
D. McG. Reid, Milton ..	3·62	4·45	4·20	4·18	5·02	4·75
H. S. Sheat, Bushey ..	2·93	3·85	3·17	3·14	3·64	3·28

* Area not harvested.

Table 4.—Summary of Results of Hay Manurial Trials on Type B Pastures.

Treatment.	Yield in Tons per Acre.							
	First Year.		Second Year.		Third Year.		Average Annual	
	Average of Nine Trials.	Relative Yields.	Average of Eight Trials.	Relative Yields.	Average of Six Trials.	Relative Yields.	Yield of Hay.	Relative Yields.
Control ..	1·12	100	1·06	100	1·17	100	1·11	100
Super ..	1·67	149	1·41	133	1·37	117	1·48	133
Slag ..	1·26	113	1·21	114	1·27	109	1·24	112
Lime ..	1·20	107	1·05	100	1·22	104	1·15	104
Super and lime	1·75	156	1·32	125	1·37	117	1·48	133
Slag and lime	1·35	121	1·13	107	1·30	111	1·26	114

to the control plots, and to slag when used alone or in combination with lime. At no stage did slag equal the increases obtained from

super, and conclusive evidence was obtained that on pastures of this type, and under the soil and climatic conditions prevailing, superphosphate was superior to slag. Although fairly marked differences were observed during the second season, a general levelling-down took place during the third season. On this type of pasture practically no results of a measureable nature were obtained from the use of lime alone.

Table 4 summarizes the results obtained from type B pastures.

Experiments on Type C Pastures.

Eleven experiments were conducted on type C pastures, and of these all were harvested during the first season, ten during the second season, and six during the third season. Type C pasture represents a large area of Otago's pastoral land, to which many farmers have recently been giving attention by manuring in the hope of making them more productive or at least maintaining their existing productivity. From this point of view it is extremely interesting to note just what results have been obtained from the use of phosphates and lime on this type of pasture. This information is summarized in Table 5.

Remarks on Table 5: There can be no question that the application of superphosphate and super plus lime has clearly demonstrated its superiority during the first and second seasons. Even during the third season, despite the fact that the effect of all fertilizers has largely disappeared, an increase from the use of a combination of lime and super is indicated. The greatest increases occurred during the first

Table 5.—Results of Hay Manurial Trials on Type C Pastures.

Farmer's Name.	Yield in Tons of Hay per Acre.					
	Control.	Super.	Slag.	Lime	Super plus Lime.	Slag plus Lime.
	First Year.					
C. Body, Kelso .. .	0·85	1·06	1·00	0·95	1·06	1·05
Cockburn Bros., Te Houka ..	1·57	2·31	1·81	1·65	2·45	1·83
J. Clarke, Wairuna	1·50	1·72	1·66	1·65	2·15	1·90
A. Craig, Greenfield	0·60	0·75	0·71	0·61	0·75	0·78
M. A. Kinney, Hyde.. ..	0·50	1·16	0·58	0·56	1·21	0·75
W. McMillan, Herbert ..	0·57	0·62	0·55	0·61	0·75	0·75
J. A. Payne, Waikouaiti ..	0·50	0·71	0·63	0·56	0·73	0·58
R. J. E. Smith, Wedderburn ..	0·22	0·43	0·23	0·25	0·45	0·26
A. Spencer, Berwick ..	1·62	2·21	2·08	1·65	2·23	1·92
W. S. Trotter, Hillgrove ..	0·83	1·48	0·93	0·96	1·53	1·08
J. Withers, Maungatua ..	0·98	1·35	1·27	1·00	1·28	1·30
	Second Year.					
C. Body, Kelso	0·60	0·62	0·75	0·60	0·75	0·75
Cockburn Bros., Te Houka ..	0·92	1·05	1·00	0·95	1·10	1·12
J. Clarke, Wairuna* ..	..	..	..	..	..	..
A. Craig, Greenfield	0·72	0·80	0·90	0·72	0·85	0·90
M. A. Kinney, Hyde.. ..	0·70	0·82	0·72	0·76	0·90	0·80
W. McMillan, Herbert ..	0·20	0·20	0·21	0·21	0·20	0·25
J. A. Payne, Waikouaiti ..	0·42	0·42	0·45	0·45	0·40	0·45
R. J. E. Smith, Wedderburn ..	0·65	0·85	0·75	0·72	1·00	0·85
A. Spencer, Berwick ..	2·55	3·12	2·75	2·60	3·22	2·80
W. S. Trotter, Hillgrove ..	0·60	0·60	0·52	0·52	0·55	0·50
J. Withers, Maungatua ..	1·65	1·95	1·95	1·70	1·95	1·90

Table 5—continued.

Farmer's Name.	Yield in Tons of Hay per Acre.					
	Control.	Super.	Slag.	Lime.	Super plus Lime.	Slag plus Lime.
			Third Year.			
C. Body, Kelso*	..	..	..	..	..	..
Cockburn Bros., Te Houka ..	1·00	1·25	1·02	1·00	1·25	1·00
J. Clarke, Wairuna* ..	..	..	..	..	..	..
A. Craig, Greenfield* ..	..	..	..	..	..	..
M. A. Kinney, Hyde.. ..	1·10	1·02	1·10	1·02	1·10	1·02
W. McMillan, Herbert* ..	..	..	..	..	..	..
J. A. Payne, Waikouaiti* ..	..	..	..	..	..	..
R. J. E. Smith, Wedderburn ..	0·52	0·60	0·57	0·62	0·70	0·62
A Spencer, Berwick ..	1·50	1·52	1·55	1·50	1·55	1·52
W. S. Trotter, Hillgrove ..	0·85	0·85	0·85	0·90	0·92	0·85
J. Withers, Maungatua ..	1·55	1·62	1·62	1·50	1·55	1·52
		Total Yield for Three Seasons.				
C. Body, Kelso	1·45	1·68	1·75	1·55	1·81	1·80
Cockburn Bros., Te Houka ..	3·49	4·61	3·83	3·60	4·80	3·95
J. Clarke, Wairuna	1·50	1·72	1·66	1·65	2·15	1·90
A. Craig, Greenfield	1·32	1·55	1·61	1·33	1·60	1·68
M. A. Kinney, Hyde.. ..	2·30	3·00	2·40	2·34	3·21	2·57
W. McMillan, Herbert ..	0·77	0·82	0·76	0·82	0·95	1·00
J. A. Payne, Waikouaiti ..	0·92	1·113	1·08	1·01	1·13	1·03
R. J. E. Smith, Wedderburn ..	1·39	1·88	1·55	1·59	2·15	1·73
A. Spencer, Berwick ..	5·37	6·85	6·38	5·75	7·00	6·24
W. S. Trotter, Hillgrove ..	2·28	2·93	2·30	2·38	3·00	2·43
J. Withers, Maungatua ..	4·18	4·92	4·84	4·20	4·78	4·72

* Area not harvested.

season after application, with a rapid levelling down taking place during the second season. The effect of basic slag and slag plus lime is noticeable, though to a lesser extent than superphosphate during the first season, but the effect of slag is not materially continued beyond the first season. Lime alone has not appreciably increased the yield of hay during any season under review.

A summary of the yields is given in the following table:—

Table 6.—Summary of Results of Hay Manurial Trials on Type C Pastures.

Treatment.	Yield in Tons of Hay per Acre.							
	First Year.		Second Year.		Third Year.		Average Annual	
	Average of Eleven Trials.	Relative Yields.	Average of Ten Trials.	Relative Yields.	Average of Six Trials.	Relative Yields.	Yield of Hay.	Relative Yields.
Control ..	0·88	100	0·90	100	1·08	100	0·95	100
Super ..	1·25	142	1·04	116	1·14	106	1·14	120
Slag ..	1·04	118	1·00	111	1·12	104	1·05	111
Lime ..	0·95	108	0·92	102	1·09	101	0·98	103
Super plus lime	1·32	150	1·09	121	1·17	108	1·18	124
Slag plus lime	1·10	125	1·03	114	1·09	101	1·07	113

Experiments on Type D Pastures.

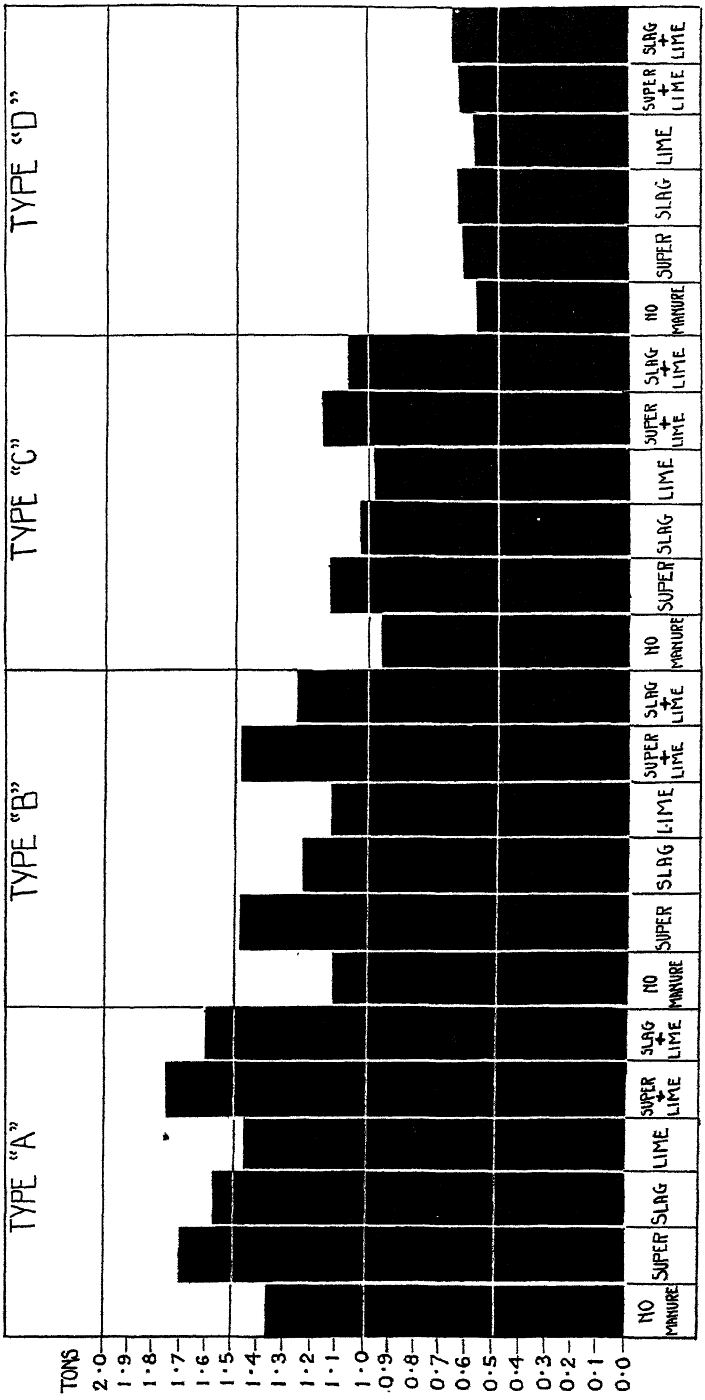
The pastures designated type D were, generally speaking, of low production and comprised chiefly of brown-top. Brown-top occupies a considerable area of South Otago, and many farmers are entirely dependent upon it for grazing. It is of considerable economic importance, and unquestionably, when well controlled, carries a surprising number of sheep, considering its reputed low-feeding value. There is no doubt that by increasing the fertility of the soil, better species of grasses than brown-top can be encouraged to grow on Southern hill country; but as so great an area of the pastures of South Otago are largely composed of this grass, trials under the D series were instituted to determine the effects of manuring on pastures of this type. During the first year seven experiments were harvested, and five during the second season. The trials on this type of pasture were then discontinued, as the results obtained during two seasons did not warrant further continuation.

Table 7.—Results of Hay Manurial Trials on Type D Pastures.

Farmer's Name.	Yield in Tons of Hay per Acre.					
	Control	Super.	Slag.	Lime	Super plus Lime.	Slag plus Lime.
	First Year.					
J. Cotton, Evans Flat ..	0·26	0·40	0·31	0·28	0·32	0·31
G. L. Cunningham, Hillend ..	0·50	0·55	0·56	0·52	0·55	0·55
Major Hickey, Waipahi ..	0·31	0·53	0·43	0·33	0·58	0·50
S. Ottrey, Heriot	0·55	0·62	0·56	0·58	0·62	0·58
W. B. Paterson, Stuart Downs	0·21	0·28	0·21	0·22	0·31	0·22
R. Thompson, Lawrence ..	0·82	0·80	1·05	0·90	0·90	1·22
V. Wilson, Greenfield ..	0·77	0·91	0·78	0·78	0·92	0·82
	Second Year.					
J. Cotton, Evans Flat ..	0·65	0·80	0·82	0·70	0·90	0·85
G. L. Cunningham, Hillend ..	0·72	0·70	0·72	0·72	0·70	0·70
Major Hickey, Waipahi ..	0·35	0·41	0·42	0·35	0·42	0·38
S. Ottrey, Heriot*	..	..	..	..	..	..
W. B. Paterson, Stuart Downs	1·10	1·00	1·20	1·02	0·92	1·15
R. Thompson, Lawrence ..	0·45	0·52	0·60	0·52	0·55	0·65
V. Wilson, Greenfield* ..	..	..	..	..	..	..
	Total Yield for Two Seasons.					
J. Cotton, Evans Flat ..	0·91	1·20	1·13	0·98	1·22	1·16
G. L. Cunningham, Hillend ..	1·22	1·25	1·28	1·24	1·25	1·25
Major Hickey, Waipahi ..	0·66	0·94	0·85	0·68	1·00	0·88
S. Ottrey, Heriot	0·55	0·62	0·56	0·58	0·62	0·58
W. B. Paterson, Stuart Downs	1·31	1·28	1·41	1·24	1·23	1·37
R. Thompson, Lawrence ..	1·27	1·32	1·65	1·42	1·45	1·87
V. Wilson, Greenfield ..	0·77	0·91	0·78	0·78	0·92	0·82

* Area not harvested.

Remarks on Table 7: It is quite obvious that on low-production pastures of this nature the application of artificial fertilizer, so far as increased hay production is concerned, is not warranted, and that greater economic results will accrue by applying fertilizers to a better and more productive type of pasture. Very slight gains were received from the application of phosphates and lime, and in the second season



GRAPH ILLUSTRATING ANNUAL AVERAGE HAY PRODUCTION IN THE PASTURE TOP-DRESSING TRIALS OVER THE SEASONS 1927, 1928, AND 1929 (SEE NEXT PAGE).

basic slag, alone and in combination with lime, showed a slight increase which was barely significant. The following tabulation summarizes the two seasons' results :—

Table 8.—Summary of Results of Hay Manurial Trials on Type D Pastures.

Treatment.	Yield in Tons of Hay per Acre.					
	First Year.		Second Year.		Average Annual	
	Average of Seven Trials.	Relative Yields.	Average of Five Trials.	Relative Yields.	Yield of Hay for Two Seasons.	Relative Yields.
Control ..	0·49	100	0·65	100	0·57	100
Super	0·58	118	0·68	105	0·63	111
Slag	0·56	114	0·75	115	0·65	114
Lime	0·52	106	0·66	101	0·59	104
Super plus lime ..	0·60	122	0·71	109	0·65	114
Slag plus lime ..	0·60	122	0·74	114	0·67	118

SUMMARY OF AVERAGE ANNUAL YIELDS.

The accompanying graph indicates the value of superphosphate and a combination of super and carbonate of lime for hay production on pasture types A, B, and C. This graph depicts the average annual production—not the total production—obtained from the various fertilizers over the three seasons of the duration of the trials. On account of the general falling-off and levelling-down of all manurial differences during the second and third seasons, the differences in heights of the individual production columns is appreciably lessened, but there can be no question as to the superiority of superphosphate and lime throughout the trials.

CONCLUSIONS IN BRIEF.

(1) The experiments conclusively point to the fact (with one exception mentioned) that superphosphate and carbonate of lime when used in conjunction give better hay yields than superphosphate or basic slag when these are used alone, or than a combination of basic slag and carbonate of lime.

(2) Superphosphate when applied as a top-dressing proved superior to basic slag on all pasture types with the exception of type D, whereon no material differences were recorded.

(3) The effect of dressings of 1 ton of carbonate of lime alone is of a limited nature, in so far as hay production is concerned.

(4) The greatest increases in hay-production occur in the first season, with a rapid falling-off in production occurring during the second and third seasons.

(5) The results indicate that top-dressing should be carried out annually.

Acknowledgment is made to the various officers of the Fields Division in Otago who were responsible for the conduct of the experiments, and to those farmers who co-operated with the Department in carrying the trials through to a successful conclusion.

INFLUENCE OF DIETARY IRON ON HAIR AND WOOL GROWTH.

I. J. CUNNINGHAM, Chemistry Section, Department of Agriculture.

IN this short article it is proposed to indicate—more particularly for the practical wool-grower—some effects of experimentally controlling the amounts of iron in the diets of rats on the growth of their hair coats.

To begin with, young rats were fed a ration very low in iron. The ration was a good one in other respects, being composed of the following materials: Casein 15 per cent., flour 40 per cent., castor sugar 30 per cent., lard 5 per cent., dried yeast 3 per cent., cod-liver oil 3 per cent., mineral mixture (no iron) 4 per cent. This was fed to the maternal animals as soon as the young commenced to share their food, and was continued for the young animals after weaning.

In one experiment twelve young animals were fed in this manner, and thirty-seven days after weaning all had developed extensive hairlessness, a typical illustration of which appears in Fig. 1. Over the same period a practically normal coat was maintained by six similar rats which had received the same ration, but with a daily addition of a very small quantity of limonite (hydrated iron oxide) after weaning. A photo of one of these rats is reproduced in Fig. 2. This result was confirmed in another similar experiment.

In order to test the effect of iron further, some of the hair-deficient rats were fed a daily ration of iron in addition to their low iron diet. In three weeks a normal hair coat had grown, as is seen from Fig. 3 where the illustration is of the same rat as that in Fig. 1.

Throughout the experiments periodic hæmoglobin determinations were made in the blood of all animals, and the results confirmed the view that the practically hairless rats were suffering from lack of iron, while in those which grew a normal hair coat no indication of iron deficiency was found. These conclusions received further support from determinations of the iron content of the livers of the rats at the end of the experiments, as there was much less iron in the livers of the practically hairless rats than in those of rats with normal hair coats.

The possibility of iodine deficiency causing the hairlessness was excluded by the results of feeding potassium iodide to some hair-deficient rats, while histological examination* of the skin of one of the practically hairless animals showed that skin disease had not caused the condition.

It seems, therefore, that one effect of iron deficiency in the rat may be a reduced ability to grow hair. Such an observation is of importance to the wool-grower in New Zealand, for here, as B. C. Aston has shown, large areas exist where the natural source of iron is insufficient for the needs of the animal. It is not suggested that precisely the same conditions surround the growth of hair on the rat as those surrounding the growth of wool on the sheep, but it is likely

* I am indebted to Mr. D. A. Gill, of the Wallaceville Veterinary Laboratory, for making the histological examination.

FIG. 1.

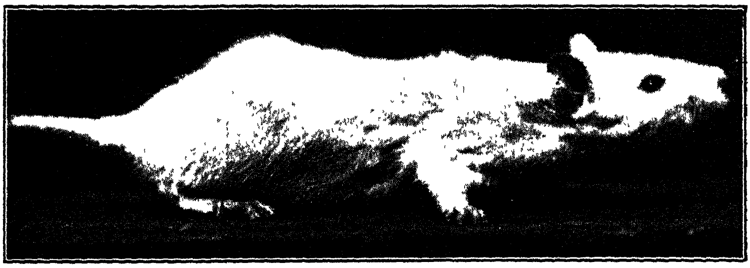


FIG. 2.

FIG. 3.

SOME OF THE RATS IN THE DIETARY IRON EXPERIMENTS.

(See references in text)

[*Photos. by R. E. R. Grimmett.*

that similar fundamental conditions obtain, and certainly likely that iron may exert an important influence. In this connection T. Rigg (Bulletin 32, New Zealand Department of Scientific and Industrial Research) has observed differences between the fleeces of sheep fed iron supplements and those deficient in iron.

To conclude, the evidence submitted indicates that iron may be an important factor in promoting the growth of wool on sheep in iron-deficient areas. This possibility should be remembered by all wool-growers, and, if necessary, advice may be obtained from Agriculture Department officers as to the best method of administering iron to the flock.

THE TUNG-OIL TREE.

CULTIVATION EXPERIENCE IN NORTH AUCKLAND.

E. T. FROST, Lake Ohia, North Auckland.

CONSIDERABLE interest is being taken in the planting of the tung-oil tree (*Aleurites Fordii*) in the northern part of Auckland Province. Some thousands of acres have been selected for plantations, and at the present time are being ploughed and cultivated preparatory to the planting-out of the young trees which are now growing in the nurseries. Up to the present the main work has been confined to the nursery, of which there are several, with probably half a million young plants.

There are peculiarities in the germination of the tung seed and the growth of the young plant which have, or should have, a bearing on the selection of a site and the preparation of the ground prior to planting the seed. If possible, it would be wise to prepare the ground a season ahead of the planting in the nursery. A crop of potatoes would prove an excellent way to clean a nursery plot. If this is done, and the ground is kept stirred up regularly after the harvesting of the cleaning crop, the land ought to be reasonably free of weeds by planting-time.

Tung seeds germinate rather unevenly, and, as it will be at least three months after planting before much intercultivation can be carried out, if the ground is not clean there will be a great growth of weeds, which will not only rob the seedlings but constitute a source of danger when weeding does take place.

Shelter is all-important in the nursery. If the young plants are thriving as they ought, three months after coming through they should be between 2 ft. and 3 ft. in height, and making growth vertically at the rate of not less than 3 in. per week. At this stage they will have from fifteen to twenty leaves, the largest of which will be from 10 in. to 12 in. across and about the same length. It will be thus seen that a large surface will be presented to the wind. Later on, as the tree matures, the leaves become smaller.

Some experiments have been carried out with seedlings in exposed positions, and it is interesting to note that they are very tough and stand up well to severe conditions; but, of course, as with most other trees, shelter will greatly assist the growth, and the risk of blossoms being damaged will be greatly minimized.

FIG. 1. PART OF TUNG PLANT NURSERY, NEAR MANGONUI.
Seed sown 6th September, 1931; photo taken 6th March, 1932.

FIG. 2. TUNG PLANT IN THE NURSERY, 3 FT. HIGH.
Seed sown 26th August, photo taken 6th March.

In the nursery under consideration, situated near Mangonui, the first planting of seed was made on 15th August last and several days following. A second lot was planted a fortnight later, and the main area, some 3 acres, was planted early in October. The quickest and most regular germination took place in the last planting, although the second one was nearly as good. The first planting was slower in germinating, but at time of writing (end of March) it is making good headway, and will probably by the beginning of the winter be almost as forward as the main planting.

From this one would deduce that there is nothing to be gained by early planting. The seeds evidently require a certain earth temperature to start them. Some seeds planted in May did not show through until November. The average time for germination of the August planting was fifty-six days, while that of the October planting was not over forty-five. The land is alluvial river silt, well sheltered, and underground drains have been laid to take surface water off quickly. Many of the plants at three months old are 3 ft. high, and the average would be at least 2 ft. The growth as measured on a number of plants is over 4 in. in height per week. The stems are averaging ½ in. diameter 2 in. above the ground.

Intercultivation of the nursery must be done with the greatest care, as many seeds may be just about to push the plumule above ground, and at this stage can be easily damaged. Weeding will be greatly facilitated if the seeds are planted to exact measurements, as a plant above the ground in the early stages gives the exact location of those on either side of it, and by careful working (if it is imperative to weed at this stage) these positions can be noted.

The nursery under consideration was laid out in 3 ft. rows, with 12 in. between plants. No closer planting could be recommended if growth is going to be on a par with that of plants in this district. This leaves enough space for horse or mechanical cultivation between rows in the early stages.

This nursery area, being good-quality land, was not fertilized at time of planting, but a small application of blood and bone and guano was applied after weeding. Germination has been very good, in many cases being from 75 to 80 per cent., and practically all the plants are showing excellent virility. The seed was given no special preparation. Part of them were hulled three months previous to planting, and the rest were hulled and planted right away. No variation was noticed in the germination of any of the lots.

The ground was opened up with a hoe to depth of about 2 in. to 3 in., the seeds placed in to gauge, and the row covered again with a hoe. A stake was left at the end of each row as an indicator, and proved useful as a guide in the early stage of horse cultivation. The mechanical cultivator has not yet been tried, but possesses advantages over the horse, and will probably be used to a great extent in these nurseries another season.

To summarize—after a year's experience with tung plants, one can safely lay down the principles of a summer fallow and adequate shelter as conducive to the best results. Further, if these principles are extended to the plantation subsequently the tung plant should thrive in the congenial climate of North Auckland.

IMPORTATION OF FERTILIZERS IN 1931-32.

R. E R. GRIMMETT and J A. BRUCE, Chemistry Section, Department of Agriculture.

THE usual annual summary of comparative import statistics compiled from data furnished by courtesy of the Comptroller of Customs is presented in the attached tabulated statements. These refer in some detail to prepared fertilizers and materials for fertilizer manufacture entering the Dominion during the year ended 31st March, 1932.

The returns exhibit a reduction in tonnage in almost all items, though an appreciable increase is manifested in deliveries of raw phosphate rock from Nauru and Ocean Islands. A small rise is also noted in the receipts of nitrate of soda from Chile. Notwithstanding the substantial decreases shown, some satisfaction can be derived from the fact that the total quantity of all fertilizers imported, amounting to 241,843 tons in the year under review, although considerably below the total tonnages of 262,442 and 368,762 for the respective years 1930–31 and 1929–30, is still well above the level of importations for the years 1924–25 and 1925–26. During these two years of comparative agricultural prosperity the total importations were only 167,462 tons and 174,768 tons respectively.

As might have been expected, there was a continuation of restricted and cautious importation evident from the preceding year's statistics. This policy was doubtless chiefly due to the adverse agricultural conditions which has led many users to economize to a certain extent in fertilizer purchases. The unsettled exchange position and the generally unsatisfactory market conditions were also contributory factors in causing a shrinkage in imports. Items showing the most decided reductions or changes in the importation position are briefly discussed under the following heads.

Phosphates.—Apart from the Nauru and Ocean Islands rock, which has not only felt the effect of enforced economy least of all but has shown an improvement of 28,582 tons, or 24 per cent., over last year's quota, practically every item in this group has registered comparatively large losses. Bonedust, the importation of which has lately been prohibited, has dwindled to an insignificant amount of only 160 tons. The retrograde movement in importation of basic slag apparent in 1930–31 was continued in a pronounced manner during the year, partly accountable for which was both the shortage of supplies through inactivity of the steel industry and the unstable foreign exchanges. Over 9,000 tons of slag were from Great Britain—an increase of 50 per. cent. over last season's receipts from this source. Much better grades of "open hearth" slag, with a higher percentage of citric-soluble phosphoric acid plant-food than was the case for a good many years past, are now on the British market. The probability is that the current year will see a further expansion of the importation of this commodity from Britain to the Dominion.

Another outstanding feature is the absence of raw phosphates imported direct from North African mines—in Morocco, Tunisia, and Egypt—in the past twelve months. In former years all three countries have participated prominently in supplying New Zealand with phosphates for direct application to the land. Possibly some of the phosphate from the large Gafsa mines in Tunisia, usually ground in Belgium or elsewhere in Europe, may be included under the description "Phosphate not otherwise specified."

Undoubtedly the stimulus to the domestic consumption of high-grade superphosphate (20·1 per cent. of phosphoric acid plant-food) occasioned by a State subsidy of 12s. per ton on its selling-price has considerably influenced the import position of basic slag and other commodities in the phosphate class.

Nitrogen.—Despite concentrated efforts being made by certain organizations in the direction of increasing the quantity of inorganic nitrogen fertilizers used chiefly in pasture production in this country, the year witnessed a considerably smaller importation of sulphate of ammonia than in the two preceding years. A slight increase, as already pointed out, is apparent in the case of Chilean nitrate of soda, a certain amount of which is employed for chemical manufacture.

Potash.—Imports of various grades, which showed a rapid relative rise to a maximum of 13,429 tons in 1928–29, suffered a further decline to

TABLE I.—SUMMARY OF FERTILIZER IMPORTATIONS, 1931–32 AND 1930–31.

Fertilizer.	Quantity.		Declared Value.*	
	Year 1931–32.	Year 1930–31.	Year 1931–32.	Year 1930–31.
	Tons.	Tons.	£	£
Bonedust and bone-char ..	180	795	993	6,964
Basic slag	47,776	67,766	119,191	189,091
Superphosphate (concentrated) ..	300	..	2,014	..
Nauru and Ocean Islands phosphate	148,060	119,478	198,842	141,090
Island phosphate (other) † ..	30,406	37,472	44,800	61,652
Moroccan phosphate	..	8,038	..	10,919
North African phosphate (other)	..	250	..	505
Phosphate (not otherwise specified)	4,738	13,405	12,378	33,708
Kainit	334	997	971	2,752
Muriate of potash	65	50	844	394
Sulphate of potash	648	1,310	6,867	13,631
Potash salts (other)	3,581	5,833	16,480	26,161
Sulphate of ammonia	4,785	6,170	38,160	58,510
Nitrate of soda	920	754	7,915	7,628
Cyanamide	..	30	..	255
Sulphate of iron	45	2	233	20
Fertilizers unspecified	5	92	101	1,180
Totals	241,843	262,442	449,789	554,460

† Includes phosphate from Tuamotu Archipelago, Seychelles Islands, New Caledonia, and Madagascar (for details see Table 3).
* NOTE.—The values shown in the above table are those declared for Customs purposes, and represent the current domestic values in the countries of exportation, plus 10 per cent.

TABLE 2.—IMPORTS OF THE PRINCIPAL PHOSPHATIC FERTILIZERS, 1923–32.

Year ended 31st March,	Bonedust and Bone-char.	Basic Slag.	Super-phosphate.	Pacific and Indian Oceans Phosphate.	Egyptian Phosphate.	Moroccan Phosphate.	North African Phosphate (other).
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1923 ..	2,446	19,641	..	69,591	..	..	..
1924 ..	4,158	39,632	255	76,517	5,996	..	..
1925 ..	2,452	45,682	10	108,163	8,530	..	..
1926 ..	2,085	44,314	500	97,488	10,037	..	..
1927 ..	1,805	53,327	15	161,541	5,979	..	..
1928 ..	725	48,913	6,616	143,373	6,603	13,389	..
1929 ..	554	93,222	1,037	178,057	6,000	22,173	12,499
1930 ..	1,420	94,332	525	170,997	1,000	35,348	37,424
1931 ..	795	67,766	..	156,950	..	8,038	250
1932 ..	180	47,776	300	178,466	..	..	..

TABLE 3.—IMPORTATION (IN TONS) OF PRINCIPAL COMMERCIAL FERTILIZERS FOR YEAR 1931–32, SHOWING COUNTRIES OF ORIGIN AND NEW ZEALAND PORTS OF ENTRY.

New Zealand Port of Entry.	Chile.	India.	Australia.	Pacific and Indian Ocean Islands.		Great Britain.			Belgium.			France.			Germany.			Netherlands.			Poland.
	Nitrate of Soda.	Bonedust.	Bone-char.	Source.	Raw Phosphate.	Sulphate of Ammonia.	Basic Slag.	Phosphate.	Basic Slag.	Phosphate.	Potash.	Basic Slag.	Phosphate.	Potash.	Basic Slag.	Super-phosphate (Double).	Potash.	Basic Slag.	Super-phosphate (Double)	Phosphate (Mineral).	Potash.
				Nauru/Ocean .	90,363																
Auckland ..	655	140	..	Tuamotu	6,094	2,515	3,279	15	23,704	1,970	15	50	..	895	50		1,275	300	50	700	277
				Seychelles ..	2,957																
New Plymouth	90	..	..	Nauru .. .	11,554	275	4,478	..	9,194	950	100	.	..	98		.	50	.	..		175
				Tuamotu	3,438																
				Nauru/Ocean ..	14,428																
Wanganui ..	..	..	..	Tuamotu ..	3,268	..	..	.	..	..	..	..	.	..		.	..		..	..	..
				New Caledonia ..	1,477																
Napier ..	..	..	.	..	..	..	..	..	..	..	.	.		..			7	..	.	.	..
Wellington ..	10	..	..	..	..	600	920	23	2,836	100	5	.		95	..		100	.	..		195
Nelson ..	..	.	..	..	..	75	.	5	730	100	..	.		10	.		10		..	..	25
				Nauru/Ocean ..	8,978																
Lyttelton ..	40	15	..	Tuamotu	1,501	375	.	.	100		15	.		30	.	100	92		25		10
				New Caledonia .	1,400																
				Madagascar	793																
Timaru ..	..	..	..	New Caledonia ..	723	30	..	..	..	50	..				.		..	..	..		..
				Nauru/Ocean ..	22,737																
Dunedin ..	125	5	..	Tuamotu .. .	1,937	675	.	..	250	375	..	25	25	191	.		215		125		10
				New Caledonia .	748																
				Madagascar ..	2,428																
Invercargill ..	..	..	20	Seychelles .. .	3,642	240	495	165	1,365	160	.			210	..	..	135			100	25
Totals ..	920	160	20	..	178,466	1,785	9,172	208	38,179	3,705	135	75	25	1,562	50	100	2,211	300	200	800	717

4,628 tons during the year 1931–32. An amount of 717 tons came from Poland, a new source of supply for New Zealand. Only relatively small quantities of potash, chiefly in the form of potash (chloride) salts, as yet find application in our local farm practice. The principal use of the potash-bearing fertilizers is for incorporating in proprietary mixed manures, for grassland top-dressing and orchard culture.

General.—It may be of interest to mention that the percentage of prepared fertilizers imported either for direct application to the soil or for mixing purposes now approximates 33 per cent. of the total importations, while fertilizer materials, chiefly in the form of raw phosphates for superphosphate manufacture, amount to 67 per cent. or thereabouts. The percentage decreases in the totals of each group compared with last year are: Phosphatic fertilizers, 6·4 per cent.; nitrogenous, 18 per cent.; potassic, 43·5 per cent.

TREATMENT OF DEVITALIZED APPLE-TREES.

M. DAVEY, Orchard Instructor, Mapua.

THROUGHOUT the commercial fruit-producing districts of New Zealand, and especially in those areas where orchards have been established on hilly or second-class land, there exist a large number of individual apple-trees which have declined in vigour, ceased their development of wood growth, and whose carrying-capacity shows no profit over the cost of production. In most cases this class of tree can be avoided by judicious treatment and special attention from the time at which full cropping commences. When debility has been established for some considerable period, correction or rejuvenation of the tree is more difficult and often a slow process. However, it is seldom that the condition cannot be materially modified if not entirely eliminated.

Generally speaking, the direct cause or causes of debility are not difficult to ascertain and remedy The chief factors operating comprise the following—(1) Insufficient nutrition; (2) neglect to maintain a healthy condition of foliage; (3) overcropping; (4) lack of conservation of soil moisture; (5) indifferent drainage. These subjects will be briefly dealt with seriatim.

NUTRITION.

In cases coming under this heading it is recommended that special treatment with manures be the first aim, with the object of stimulating and increasing the green tissues throughout the tree represented by its annual extensions of growth and the leaf system. To achieve this object recourse must be made to fertilizers rich in nitrogen and of a highly soluble nature. Ranking first among such manures are sulphate of ammonia and nitrate of soda. On present market values sulphate of ammonia commands consideration, providing as it does the maximum nitrogen content at the lowest unit cost. An effective and not excessive application of 4 lb. to 6 lb. of this fertilizer per tree in early winter may be expected to greatly stimulate growth during the ensuing season. The acidifying effect of the manure may be no disadvantage; but if such is considered to be the case a top-dressing of 1 lb. of nitrate of soda applied in early spring will tend to neutralize this effect.

When a pronounced extension of growing terminals has been realized, and the foliage has shown a marked increase in leaf surface, a return to complete fertilizers is advisable; phosphatic manures stimulate the root system, while potassic manures tend to tone up the tree and refine the fruit.

It may be noted that stimulation of those parts of the tree above ground will automatically induce a healthy demand on the roots, the excitement of which should lead to extensions into ground which has not previously been explored by the root system.

Maintenance of a Healthy Leaf System.

Neglect to maintain a healthy condition of foliage is probably one of the most common and serious causes of debility in apple-trees, and does not appear to exercise the minds of orchardists to the extent that is warranted. Although most instances of spray burn are attributed to the caustic nature of the compounds applied, in very many instances burning is only secondary to the impoverished condition of the foliage previous to the application of the spray. Failure to appreciate the devitalizing effects of heavy infestations of red-mite and apple leaf-hopper may be regarded as one of the weakest links in commercial fruitgrowing in the past. Until recently adequate control of these two insects has been costly and difficult, but with the advent of emulsified oils which can be used with safety during the late summer the position has been greatly relieved.

Practical experiments carried out by the Horticulture Division during the last two seasons with summer applications of emulsified oils have established the fact that not only can effective controls be obtained, but that other benefits are also derived. It has been indicated that one application of oil causes a partial if not entire suspension of feeding by the insects, enabling the leaves to accumulate and restore a substantial amount of the depleted chlorophyll. The freshening of the foliage also suggests that excessive transpiration is partly suspended by the film of oil covering the leaves.

It is all important that orchardists whose sole anxiety in the past has been to keep the fruit free from deposition of red-mite eggs should realize that the maintenance of a generous and vigorous leaf system for the natural period subsequent to leaf fall is an important factor in building up the development of fruit buds for the following season. Where red-mite is prevalent—and it is common in most districts subject to dry climatic conditions—orchardists are earnestly recommended to consider applications of oil sprays to each variety immediately after harvesting that variety, and thus minimize the adverse effects referred to.

Prevention of Overcropping.

It may be truly said that overcropping is a fruitful source of depletion of the vigour of many trees. Reflection will remind one of the fact that the modern apple-tree is a highly developed organism, vastly different in many respects to its original parent. Commencing life budded or grafted on to the root of other selected varieties, it is handicapped at the start by an interrupted root-system. Prior to man's interference with the original type by selection and hybridization the fruit was approximately one-tenth of the size of that now produced

on most modern varieties. To be consistent with these radical changes in type, control or limitation of the crop becomes a necessity for the commercial orchardist.

Apple-trees, unfortunately, in common with a great number of other plants, become more fruitful as vigour declines, rendering it incumbent on the grower to offset this tendency by preventive measures. In advanced stages of debility the most effective and rapid measure is to entirely remove at pruning period all fruit spurs, cutting back to within ½ in. of the branches from which the spurs have grown. This may appear an extreme or drastic process, but experience shows that entire removal of crop is seldom attained, many fruits being produced on adventitious growths the first season after treatment. In many cases by the second season the tree will be carrying a quantity of fruit equal to the amount produced prior to treatment.

Where debility is not so far advanced or pronounced judicious thinning at fruit-set may be sufficient ; reduction of the clusters, or thinning to one fruit per cluster, should serve the purpose. It may be noted that in most instances a reduction of fruit spurs during the dormant season, and consequent limitation of blossom, will often effect a more prolific setting of fruit than would occur if no restriction of bloom had been imposed.

Conservation of Moisture.

Dealing with lack of sufficient moisture, it should be borne in mind that the roots of plants absorb most food substances in liquid form by the process termed osmosis. When the moisture content falls below a given point the function of osmosis is greatly reduced or ceases. With sufficient moisture many insoluble plant nutrients which occur in the soil are made soluble and available to the tree by the action of soil acids. Also, organic acids secreted by the roots, and which act as solvents of insoluble matter, are impotent in the absence of moisture. For these substantial reasons it may be accepted that a uniform and sufficient moisture content is essential to healthy growth. In most instances weak trees are shallow-rooted, and for that reason it is imperative that an effective mulch be maintained in order to bring the action of capillarity close to the surface.

Adequate Drainage.

The importance of adequate drainage need hardly be stressed when one considers the influences brought to bear by it on the soil. The penetration of plant-foods to the subsoil is largely dependent on the percolation of rainfall. Drainage raises the temperature of the ground, thereby causing an early spring growth of the tree. Aeration of the soil, which follows displacement of surface water, is essential to those micro-organisms which exert considerable beneficial influences on the plant. Indifferent drainage allows accumulation of substances which are toxic to plant-life.

Sheep wintered on Oat Silage.—Last year a farmer at Te Wharau, Wairarapa, wintered 600 two-tooth wethers on oat silage, carrying them through in good store condition with a ration of about 3 lb. per head daily. The silage was fed out on a bare rape paddock.

FARMERS' FIELD COMPETITIONS.

TARANAKI, WELLINGTON, AND HAWKE'S BAY DISTRICTS, SEASON 1930-31.

R. P. CONNELL, Fields Division, Department of Agriculture, Palmerston North.

THE Taranaki, Wellington, and Hawke's Bay Districts farmers' field competitions in the 1930–31 season were of the same general nature as those of recent previous years. The total number of entries judged was greater than in any earlier season. The following notes place on record the main features and results of the work.

The entries judged in each of the several districts during the season under review and 1929–30 were as follows :—

	1930–31.	1929–30.
North Taranaki	306	327
South Taranaki	190	143
Wanganui	22	32
Feilding	10	11
Wairarapa	17	4
Hawke's Bay	15	6
Total	560	523

Apart from a Hawke's Bay competition, in which five entries were judged, the ensilage competitions were confined to Taranaki, where they are growing in popularity, as may be seen from the following figures relative to the number of entries judged: 1926–27, 37; 1927–28, 67; 1928–29, 130; 1929–30, 191; 1930–31, 222.

In general there was a falling-off in root-crop entries in 1930–31, which in Taranaki was more than counterbalanced by an increase in ensilage entries. This is a continuation of a tendency which was discussed in the report of the 1929–30 competitions, and which was attributed to the more general and live interest in ensilage methods.

MANGELS.

The mangel-growing competitions for all districts resulted as follows :—

Table 1.

Season.	Number of Entries judged.	Yield per Acre.	
		Tons	cwt.
1928–29	92	59	14
1929–30	86	58	12
1930–31	66	53	0

The results in each district are indicated in Table 2.

The heaviest crop in the competitions was one in the Wanganui district, which was grown by H. G. Burch, Maxwell, and which yielded 88 tons an acre. This was a Prizewinner Yellow Globe crop sown on 30th October, each acre receiving 5 lb. of seed and 10 cwt. of a mixture of superphosphate and bone fertilizer. The land, which grew swedes in the 1929–30 season, was ploughed on 20th September.

Table 2.

District.	Season 1930–31			Season 1929–30.		
	Number of Entries judged.	Yield per Acre.		Number of Entries judged.	Yield per Acre.	
		Tons	cwt.		Tons	cwt.
North Taranaki	21	54	18	34	55	15
South Taranaki	20	55	6	24	63	19
Wanganui	11	53	11	18	60	12
Feilding	7	50	14	7	52	14
Hawke's Bay	7	44	15	3	49	13

In North Taranaki the heaviest crop was one of 85 tons per acre, grown by E. C. Eversfield, Ratapiko. Prizewinner Yellow Globe seed at 6 lb. per acre was sown on 4th November in drills 18 in. apart; 5 cwt. of a root-crop manure and ½ ton of salt per acre were used. The land was ploughed out of grass early in August, and disked and harrowed several times in September and October, while, subsequent to sowing, the crop was intercultivated three times.

In South Taranaki the heaviest crop was a Prizewinner Yellow Globe yielding 71 tons per acre, grown by A. T. Burke, Lowgarth. It was sown on 4th December in drills 14 in. apart, 4 cwt. per acre of root manure being used.

In Feilding the winning crop was one of 67 tons per acre, grown by T. Craine, Cheltenham. Prizewinner Yellow Globe seed at 5 lb. per acre was sown in drills 28 in. apart, on 24th October, with 5 cwt. of root manure.

In Hawke's Bay the winning crop of 48 tons was grown by K. R. Gundersen, Norsewood, who on 1st November sowed 4 lb. of Yellow Globe seed in drills 24 in. apart and used 15 cwt. of fertilizer per acre.

SWEDES.

The swede-growing competitions for all districts resulted as follows:—

Table 3.

Season.	Number of Entries judged.	Yield per Acre.	
		Tons	cwt.
1928–29	120	38	14
1929–30	69	44	17
1930–31	95	47	2

The results in each district are shown in Table 4.

The heaviest crop in the competitions, yielding 71 tons, was grown by G. H. Bell, Oakura, North Taranaki. Half the land occupied by the crop had been previously a pig paddock and other half a bull paddock. On the former portion the crop yielded 83 tons per acre and on the latter portion 59 tons. The land was ploughed in October, disked five times, harrowed twice, and rolled twice. On 14th December,

Table 4.

District.	Season 1930–31.			Season 1929–30.		
	Number of Entries judged.	Yield per Acre.		Number of Entries judged.	Yield per Acre.	
		Tons	cwt.		Tons	cwt.
North Taranaki	39	46	6	47	46	10
South Taranaki	33	46	6	15	41	0
Manawatu	3	50	0	3	28	15
Wairarapa	17	50	10	4	51	8
Hawke's Bay	3	30	0	..	..	

14 oz. of Superlative seed was sown through every coulter of a grain drill, with a turnip manure at the rate of 2 cwt. per acre.

In South Taranaki the winning crop, of 60 tons, was that of A. Johnson, Lowgarth. About mid-December 12 oz. of Masterpiece seed was sown in drills 7 in. apart, 6 cwt. per acre of a mixture of bonedust and superphosphate being used.

In Feilding district the heaviest crop of 66 tons was grown by E. M. Hare, Cheltenham. On 17th December 10 oz. of Masterpiece seed was sown in 14 in. drills, 3 cwt. per acre of Ephos phosphate being used.

In Wairarapa the heaviest crop, 67 tons, was grown by J. Wilson, Mount Bruce, who sowed 16 oz. of Superlative in 7 in. drills, using 3 cwt. per acre of swede manure.

In Hawke's Bay the heaviest crop, 35 tons, was grown by J. Hulena, who sowed 10 oz. of Superlative in 9 in. drills, using 1½ cwt. per acre of superphosphate.

CARROTS.

The carrot-growing competitions for all districts resulted as follows :—

Table 5.

Season.	Number of Entries judged.	Yield per Acre.	
		Tons	cwt.
1928–29	39	41	7
1929–30	52	42	7
1930–31	43	45	11

The results in each district are given in Table 6.

The heaviest crop in these competitions was grown by K. Muggeridge, Auroa, South Taranaki, and yielded 68 tons an acre.

In North Taranaki the heaviest crop, grown by Andrews and Osborne, Huirangi, yielded 67 tons. On 3rd December 2 lb. of Guerande seed was sown in 14 in. drills. In addition to ensilage wastage and farmyard manure, the land received 3 cwt. per acre of superphosphate.

In the Wanganui district the winning crop of 52 tons was grown by H. G. Burch, Maxwell, who sowed 2½ lb. of Guerande on 30th

Table 6.

District.	Season 1930-31.			Season 1929-30		
	Number of Entries judged.	Yield per Acre.		Number of Entries judged	Yield per Acre.	
		Tons	cwt.		Tons	cwt.
North Taranaki	12	45	0	14	39	19
South Taranaki	20	50	8	23	47	12
Wanganui	11	37	1	14	37	11
Feilding	..	..		1	22	10

November, and used 10 cwt. of a mixed superphosphate and bone manure.

Soft Turnips.

The only competiton for soft turnips—that in South Taranaki—was won by H. D. Johnson, Lowgarth. His crop of 52 tons per acre was Hardy Green Globe, sown on 7th November, in 7 in. drills, 14 oz. of seed and a mixture of superphosphate and blood and bone being used.

In 1930-31 eight crops averaged 41 tons; in 1929-30 eight crops averaged 46 tons.

Chou Moellier.

In South Taranaki three crops of chou moellier were judged. The winning crop of 45 tons, grown by A. T. Burke, Lowgarth, was sown on 1st December in 7 in. drills, 1½ lb. of seed and 4 cwt. of root manure per acre being used.

Ensilage.

In Taranaki ensilage very usefully occupies a prominent and growing place in the competitions. In North Taranaki in the 1930-31 season 137 entries were judged. Results are indicated in the following table:—

Table 7.

Class.	Number of Entries.	Winner.
Stack (grass)	86	G. F. Mehrtens, Inglewood.
Stack (other than grass)	9	W. Bridgman, Okato.
Hillside stacks	9	F. Bracegirdle, Kaimata.
Earth pits	28	A. R. Bayly, Omata.
Concrete pits	5	J. Cloke, Lepperton.

In South Taranaki 71 entries were judged. The results were as follows:—

Table 8.

Class.	Number of Entries.	Winner.
Stacks	49	W. Lyndon, Auroa.
Pits	17	J. Deegan, Auroa.
Hillside stacks	5	W. T. Seed, Matapu.

In Hawke's Bay five ensilage entries were judged, the winners being K. R. Gundersen, Norsewood (pit), and F. Merrick, Norsewood (stack).

Hay.

In Taranaki haymaking competitions are popular and instructive. In the North Taranaki district 39 entries were judged, the winner being L. Marfell, Toko. In South Taranaki 34 entries were judged, the winner being Hooker Bros., Matapu.

Pastures.

In North Taranaki pasture competitions are creating much interest and serving a valuable purpose in directing attention to good standards of pasture management. Regarding this competition in 1930-31 Mr. J. M. Smith, Fields Division, New Plymouth, reports:—

The competition for dairy pastures attracted 102 entries, and was won by Mr. G. F. Mehrtens, Inglewood.

The points allocated were the same as for the previous season—namely, good grasses, 30; clovers, 25; inferior grasses, 5; freedom from weeds, 10; denseness of sward, 15; utilization, 15: total, 100. These points appear to be fairly satisfactory. For the good grasses those species which score highest are perennial rye, cocksfoot, Poa trivialis, timothy, and dogstail. It is necessary to have not only these species present, but that the individual plants should be good leafy specimens. Next to these grasses comes Poa pratensis, a grass which, while of fair quality, occupies far too much space on our pasture lands. As far as clovers are concerned, a variety is desired, just as a good variety of species of grasses is required, only with the clovers we have not such a number of varieties to select from. Some consideration must be given to inferior grasses such as vernal, fog, &c., as it must be recognized that it is better to have the ground occupied by these species—low in production though they are—than to have the ground bare or occupied by weeds. Denseness of sward is also very desirable in the interests of high production, and the pastures should be as free from weeds as possible. The last points are given to utilization, these points indicating the degree of success achieved so far as stocking is concerned.

The entries show a very decided increase on previous years, which is an indication that farmers appreciate the value of this competition. The total entries of 102 compare with 50 in 1929-30. Details of entries are as follows (the previous year's entries being added in parentheses): Inglewood, 12 (17); Huirangi, 12 (11); Urenui, 17 (10); Kaimata, 11 (6); Lepperton, 7 (4); Tikorangi, 10 (2); Okato, 16 (0); Toko, 5 (0); Tarurutangi, 8 (0); Warea, 4 (0).

ULTRA-VIOLET LIGHT TESTS ON SAMPLES OF RYE-GRASS SEED.

In connection with the Official Seed-testing Station at Palmerston North, it has been decided that all ultra-violet light tests on samples of rye-grass—with the exception of those submitted for official purposes by officers of the Department of Agriculture—will be charged for at the rate of 2s. 6d. per test.

Samples on which fees are chargeable should be submitted either direct to the Seed-testing Station or through an office of the Department of Agriculture, and in either case they must be accompanied by the necessary fees.

SEASONAL NOTES.

THE FARM.

Some Vital Aspects of the Farming Position.

At this juncture, mainly because of the importance of the issues involved, it seems opportune to survey briefly the general farming position in so far as it is relevant to the planning of farm work for the coming few months. Of the matters which demand attention three only will be considered now.

In the first place, primarily because of the general low level of prices of farm-produce, there is greater need than has been felt for many years for increased production, provided it is secured on a sound economic basis.

Secondly, because of recent widespread adverse conditions, there is a possibility of decreased rather than increased production unless the measures adopted in the near future are more thorough than those it has been customary to adopt in the past.

Thirdly, while the New Zealand farming community has attained a relatively high standard of efficiency in the use of material resources, such as machinery, manures, and seeds, it is extremely doubtful whether our available human resources are being exploited with equal efficiency—a matter of paramount national importance in view of current unemployment problems. There is considerable evidence that many farmers have exercised parsimony rather than economy in regard to labour utilization. Two very important classes to which this seems to apply are producers of butterfat and of fat lambs.

It is known, for instance, that while certain dairy-farmers realize they could steadily increase their production to a fairly substantial extent they purposely refrain from attempting to do so, principally because any attempt would involve the employment of another farm hand. In view of the present position of the labour-market such farmers should ask themselves seriously and carefully whether their attitude can be justified economically. There is much evidence that without any considerable direct expenditure on material, and as the result merely of the better attention that more labour would make possible, the production of many herds could in the course of one season be materially increased. Often better feeding by means of the growing of suitable arable crops, by means of ensilage, or by means of cognate measures, would directly make possible a 25-per-cent. increase in production. Often the labour cost is practically the total cost of such measures—a cost which would be recovered in the value of the additional produce. Dairy-farmers as a class need to ask themselves frankly whether they are utilizing effectively the fruits of expenditure on such matters as suitable top-dressing and good herds, when they tolerate on their farms the winter hardships to stock of all types, the unsatisfactory summer feeding of dairy cows, and the all-year-round poor utilization of by-products, which extra labour would enable them almost wholly to avoid.

In the sphere of fat-lamb production instances could be cited in which certain farmers are carrying two to three ewes for every one carried on a unit of similar land by many of their neighbours. When the methods employed on the farms of high carrying-capacity are examined and compared with those used on the farms of low carrying-capacity, it is often to be found that the differences which exist arise from differences in labour utilization, and that the farms employing relatively the greater amount of labour return the greater profits.

When the employment of additional labour is suggested to farmers they often give a reply which is based on a considerable amount of truth, to the effect that domestic more than financial considerations deter them from employing as much labour as they would expect to be profitable. In other words, on many farms the matter of feeding and housing permanent or even casual labour is felt to be a real difficulty.

This difficulty, probably the greatest real one operating against the freer use of labour on farms which are devoted mainly to butterfat or fat-lamb production, promises to be eliminated in the near future. But it will be eliminated only if the farmers concerned give to the recently announced "Small-farm plan" that measure of effective support which intrinsically it deserves. If thoughtful farmers visualize correctly the adequate operation of the small-farm plan in their own district, they will picture the permanent and convenient location of a supply of labour skilled in the farm operations of the neighbourhood—a supply of labour which will obviate the necessity of the wasting of time and money which is involved in the present system of haphazardly drawing upon relatively distant sources of labour of (at times) an unknown standard of skill. It may reasonably be expected that the small-farm plan, if properly exploited, will result in the provision not only of convenient skilled labour, but also of economical labour, in that a system of mutually advantageous barter of labour, goods, and services will be found workable. For instance, labour charges might be met at times by the supplying of, say, a weaner pig or of breeding services, this resulting in an arrangement satisfactory to both parties. It is confidently believed that if the farming community consider the small-farm plan in its true position in our farming industry, it will be recognized not merely as a promising means of dealing with unemployment problems, but as a fundamentally sound means of remedying a long-felt serious weakness in the farm-labour position.

Important measures that often will need attention in the near future and that on many farms not only would lead eventually to increases in the amount of labour utilized, but also would result quickly in profitable returns, are top-dressing, drainage, formation of ensilage pits and trenches, preparatory cultivation for special cropping in excess of the amount previously carried out, as a means to improved feeding and possibly increased numbers of stock.

Pre-winter Top-dressing.

In view of the fact that recent deliveries of fertilizers have been exceptionally heavy, it would seem that generally farmers now more fully realize that good results are widely obtainable from pre-winter top-dressing. Any top-dressing that still remains to be done before the spring should be done as soon as possible; the special benefit of pre-winter top-dressing is to some extent lost if it is done when the soil is so cold that pastures have practically ceased growth until the arrival of spring conditions. The date of commencement of the period when it is too cold to top-dress grassland effectively varies according to the geographical position, so it is impossible to give guidance generally applicable, but it is certain that as a rule no avoidable delay should now be allowed to occur.

Although top-dressing should be carried out before the advent of the most inactive period of pasture growth, if this is at all possible, it may be advisable at times to top-dress during the "dead" period of pastures as an alternative to the inconvenience and, possibly, inefficiency, resulting from an unduly heavy rush of work in the spring. Phosphatic manures applied in the dormant period will exert their influence as soon as the warmth necessary for growth returns, and lost, as distinct from delayed, effect need not be considered. The same position is held to apply in general to lime and potash. But it is radically different with soluble nitrogenous manures;

if conditions unfavourable for growth prevail for any considerable time after the application of such manures their influence, judging from fairly extensive past experience, is considerably lessened.

As the top-dressing suitable for a wide range of conditions was discussed in considerable detail in the March, 1932, *Journal* the main matter that now needs repetition is the proved dominance generally of phosphates in profitable top-dressing. Almost invariably phosphates should be the foundation of top-dressing in New Zealand. Sometimes the best possible returns are not secured from phosphates unless materials containing one or more of the substances lime, potash, and nitrogen are also used. But on the whole, unless there is local evidence justifying the use of such supplements, their use is not considered judicious except in a trial manner.

Drainage.

There are thousands of acres of poorly-drained land in New Zealand which would quickly give profitable returns from money spent on drainage. Often drainage of isolated relatively small wet areas is a most profitable improvement which has the decided advantage of not necessitating heavy expenditure. Particularly when tile drains are being used, the drainage of isolated wet spots should be planned so as to locate the drain-lines in such a way that they would serve as part, and possibly as the basis, of any more comprehensive future work. In the present difficult times a point of some moment is that the first few pounds spent in drainage generally return the greatest percentage of profit—primarily because they remedy the most acutely adverse conditions.

One of the most important matters that should be kept in mind by those contemplating drainage is that money may easily be wasted—even in the case of land very poorly drained—unless the work is properly planned and carefully carried out. Considerable information about practical aspects of drainage was given in these notes in May and June, 1931, and advice is also obtainable from district officers of the Fields Division.

Seasonal Ensilage Work.

The provision of suitable ensilage pits and trenches, and the construction of home-made inexpensive ensilage equipment, offers scope on many farms for profitable utilization of labour during the relatively slack winter period. Pits and trenches are economical because they minimize wastage of crop material in comparison with the stack system of ensilage. On many farms the terraced or rolling type of land which favours the formation of suitable pits is not to be found, but the farms on which there are not suitable sites for trenches are not at all so numerous. This is indicated by the fact that in numerous instances really efficient results have been obtained by the use in almost perfectly flat paddocks of trenches approximately 4 ft. in depth. If a farm confines itself to the use of only one pit or trench, then almost necessarily there will arise the need either to cart heavy green material considerable distances, or to save silage from specific fields at such close intervals as will bring about unwelcome deterioration of their swards. As a means of avoiding the need of choosing between these undesirable alternatives, some progressive farmers provide themselves with a number of pits or trenches not all of which are filled each year. This excellent practice has the further advantage of bringing about the creation of reserves of feed—the advisability of which is well exemplified by the current feed position.

Cropping Work.

The matters relative to crop production and utilization which were discussed in last month's notes generally will also require attention in late May and June. Frequently the pulling and storing of mangels may suitably be done at this season, and this particularly applies to cases in which

the ground occupied by the mangels either will be used without delay for another crop, such as oats, or is apt to become very wet during rainy periods which may be expected soon.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Autumn Spraying of Stone Fruits.

WHERE an autumn fungicide has not yet been applied to stone fruits growers would be well advised to act in accordance with the information given in last month's notes. Where fungus diseases alone are to be dealt with bordeaux mixture will be found effective, but where insect pests are also to be contended with lime-sulphur should be substituted.

The Orchardist's Nursery.

Stocks for such fruits as pears and cherries, which may require to be purchased, should be ordered at once, and the collection of apricot, peach, nectarine, and plum stones should not now be delayed. In some parts of the Dominion it may not yet be too late to set out cherry-plum cuttings.

Planting.

Where planting is intended, whether for adding to the orchard, for filling gaps, or for replacements, the ground should be prepared well ahead of time. If the soil is in good tilth, and there is sufficient moisture without it being too wet, planting may be undertaken now in the warmer parts of the country. On the other hand, should the soil not have been properly prepared, or if it has become too wet and soggy, planting is better delayed until proper preparations are made and the soil has that degree of moisture and warmth necessary for the rapid start of the roots. When the trees arrive from the nursery they should be carefully and firmly heeled in until planting-time. Make a good trench, open up the bundles, and place the trees singly in the trench with a slope, work the soil well in among the roots so that there are no air pockets, and tramp well down. This care is necessary, as quite a number of losses have occurred through the young trees drying out before being planted, or from frost getting in among the roots.

Cultivation, Drainage, and Manuring.

In many orchards ploughing will now be one of the most important occupations, while in others this operation will be left over until the spring. The state of the soil and general management and environment of the orchard must decide the question of autumn versus spring ploughing. Where land is liable to become wet and soggy or to scour it may be wise to allow a cover-crop, even of weeds, to remain in the ground until the spring. The plough can, however, assist materially in some places by running the furrows in such a way that the surface water will drain away. Much controversy is at present taking place regarding the elimination of the plough in the orchard. Until a longer and wider experience has been gained with other implements which are being used in place of the plough it would be unwise to recommend the disuse of an implement so long and widely used.

Considerable assistance can be given to trees in many orchards or portions of orchards by a system of drainage of surplus water with tiles, stones, or even manuka, and now is the best time to undertake this class of work. In irrigated districts the levelling of the ground here and there to allow of better circulation of water, the cleaning and repairing of old races, and the making of new ones, should not be delayed too long.

Slow-acting manures, also super and sulphate of potash, may now be applied. It is good practice to plough these under in the autumn or winter, leaving the application of the quicker-acting nitrogenous manures until the spring. It is quite impossible here to recommend a general formula for manuring, as each locality (sometimes even each part of an orchard) may require different treatment. Advice should be sought from the local Orchard Instructor regarding specific treatment. Lime is generally applied from now on at the rate of 1 to 2 tons of carbonate of lime to the acre every three to five years. It should be sown on the surface of the ground and not ploughed under. A few general remarks on the manuring of fruit-trees will be given in next month's notes.

Pruning.

Pruning is still the most debated operation of the orchard. In this country it is still in a state of evolution, and has been so, to my knowledge, for the last twenty-seven years. Systems and styles are innumerable, and no set standard for a particular type of tree has yet been evolved. At the one end we have the system whereby no shoot is shortened but all cuts are made just above a lateral. At the other end is the system in which there is extensive removal of growths (especially strong ones), moderate laterals are shortened, and only very short shoots are left uncut. Between these two are many systems, modifications of one or other or both. And yet, under the guidance of experienced growers and pruners, wonderful crops of first-class fruit, with healthy vigorous trees, are being annually produced under nearly all these systems. All intelligent growers will co-ordinate their pruning with their general treatment of the trees, at the same time always having certain definite aims in view—namely, the production of a healthy vigorous tree of payable size, annually making adequate growth for current and future needs that will bear large annual crops of the highest quality and of a size suited to the market for which they are catering.

Under normal conditions these objects are best attained by moderate pruning, well balanced fertilizing and green manuring, efficient working of the soil, as far as possible the retention of an even moisture content in the soil, and adequate thinning of the crop and control of disease. The removal of worn-out timber, the shortening of moderate laterals, the shortening or removal of over-strong growths, and thinning-out to let in sunlight and air, form the most desirable type of pruning which will encourage reasonable growths and strong foliage. Where a gap has occurred in a tree, this should when opportunity offers be filled by a new leader or sub-leader. Often this may be achieved when a shoot comes up in a suitable position by leaving it unpruned for several seasons until it catches up to the surrounding leaders.

—*W. R. Lloyd Williams, Orchard Instructor, Alexandra.*

Citrus Culture.

The time is now approaching when the harvesting of citrus fruits will be receiving consideration. The chief object of any fruitgrower should be to try and create a good impression as he markets the first fruit of the season.

It is possible to commence gathering Poorman oranges before they are fully matured, or when only partly ripened, and then complete the process by artificial means. This is not good practice, and should not be carried out. The longer they are allowed to remain upon the tree within reason, the more palatable they become as a breakfast fruit. It is in this direction more particularly that growers should look for an increased market for Poorman oranges. Sweet oranges should be left to reach maturity on the

tree, otherwise the flavour will not be sufficiently good to command attention. On the other hand, overmaturity and dryness should be avoided, but this condition is not usual until well on in the season or when the trees have been frosted.

Lemons should be cut when they have reached the size that is mostly demanded. The colour is not of so much importance as the size. The fruit when cut can be stored and cured before it is ready for marketing.

During the next few months growers will no doubt be anticipating occasional frosts. This subject was dealt with in the citrus notes in the *Journal* for May, 1931, and I would strongly advise growers who may be subject to such visitations to try and safeguard their crops by putting into operation the measures there indicated.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Management of the Breeding Hens.

Now that the hens previously selected as prospective breeding specimens will have in most cases completed the moulting process, it is important that they be specially fed and managed in order to ensure their being in the best possible breeding condition when the mating season arrives.

As the birds are not producing there will be a tendency for them to become overfat, a condition which should be avoided at all costs from now on to the termination of the breeding season. There is ample proof that the hen carrying surplus fat does not produce desirable progeny. While it is true that the high-type layer when in a laying condition cannot be overfed on proper egg-producing food, it is possible to make even a good laying bird overfat when she is on a diet such as is desirable for breeding birds, when there should be little forcing ingredient, such as meat or its substitutes, included in the ration. It will generally be found that better incubating results will be obtained and stronger chicks produced from the feeding of a variety of whole grains, such as wheat, oats, maize, and barley, for both morning and evening meals.

Then, if the birds are to be maintained in their best vigour and the formation of body fat prevented, they must be compelled to exercise as much as possible. The best means is to make them scratch for the grain ration in deep litter. In addition, and where possible, a free range should be given, or at least a good-sized yard, affording some semblance to the condition their nature demands. In a general way, the coddled bird is far from the ideal specimen to breed from for the maintenance of a heavy-producing flock.

No attempt should be made to force the birds to a laying point in the shortest time possible, or to secure a high egg-yield by including in the ration a large proportion of forcing food such as meat, as this will generally result in weak fertility, poor hatches, and the production of chicks that are difficult to rear. Obviously, a bird that has been forced to the limit for egg production right into the late autumn, and has later to undergo the heavy strain entailed on the system by moulting and renewing its feathers, will not be in a fit condition at the commencement of the breeding period to produce eggs with the strongest germs unless given every opportunity to recuperate. The provision of ample green material should not be forgotten, as it is one of the chief foodstuffs for promoting good health, while a liberal supply of fresh water, gravel grit, and broken sea-shell should be in reach of the birds at all times. Above all, the quarters should be kept in a thoroughly clean state, which is the main essential in preventing disease and insect pests from making their appearance.

The Breeding Cockerels.

The foregoing advice applies in even greater force to the cockerels that have been selected for future breeding purposes. A mistake made on many plants is to give the cockerels specially selected for next season's breeding-pen treatment similar in all respects to that given the birds intended for market. The cockerel intended for table purposes should be rapidly developed, and to this end should have restricted range and a rich diet, whereas the prospective breeding male should have good range and an ample but simple ration. In other words, the market cockerel demands artificial conditions and the breeding cockerel as natural a scheme of treatment as possible. More harm is done to the future breeding cockerel by coddling from the brooder onwards than by anything else. This does not imply any stinting of food, but rather management tending to promote stamina, and nothing in this connection can take the place of full opportunity for free range under natural conditions It is easy to understand that the overfeeding of rich foods, such as meat, to birds during the developing stage and when confined in small runs or coops, is almost sure to encourage size of body rather than sound development of the limbs required to carry it. It should never be forgotten that the male bird is more than half the breeding-pen. Not only should he possess the qualities of undoubted stamina and utility, but he should have every opportunity of maintaining himself in the best possible form.

Feeding of Iodine to Fowls.

For some considerable time past the writer has frequently been asked for advice in regard to the feeding of iodine to fowls, and in order to discover as far as possible its value for this purpose comprehensive trials were recently carried out at the Wallaceville Poultry Station. The results of these experiments indicated in a striking manner that the feeding of iodine to fowls provided with a plain ration which is available to the average poultry-keeper did not have any beneficial influence on (1) egg production, (2) weight of eggs, (3) hatchability of eggs, (4) quality of chickens, (5) colour of yolk. In other words, the difference in egg-yield, the size of the eggs, their fertility and hatchability, &c., between eggs produced from the birds fed with and those from fowls without iodine was only what would be expected under ordinary conditions.

The twenty-four pullets which took part in the test were of the same age and of similar type in all respects. These were placed in single pens for several months previous to the commencement of the test. It was considered that by using females confined in single pens, both for the feeding test and as controls, their individuality could be better studied and observed than by running the birds in flocks. The male birds which took part in the test were changed to a different pen each hour daily from 9 a.m to 5 p.m., while each male was placed in a single pen by himself during the night, and some were provided with iodized food while others were not.

The morning mash was made up of 1 part whole wheat-meal by measure, 1½ parts bran, ½ part pollard, with 10 per cent. by weight of meat-meal added. The evening meal consisted of three parts of wheat to one part of whole small-sized maize. Green food—silver-beet and finely chaffed green oats—was fed daily, while broken oyster-shell, gravel grit, and clean water were in reach of the birds at all times. A potassium iodide solution made up with 11-52 grammes K.I. in 3,000 c.c. was added to the water with which the morning mash was moistened for the test birds. One fluid ounce of this solution was included in the mash for every twelve birds each day. The control birds were given a similar ration in all respects, excepting that no iodine was included in it.

Towards the termination of the feeding test, which lasted for a period of five weeks, the birds showed a decided dislike for the food in which iodine was included. In fact, the greater number of the birds absolutely refused to eat the food, prefering to wait until the following feeding-time in order to secure a meal in which iodine was not included. The fact that the birds showed a dislike for the iodized food indicates that the amount of iodine secured in a natural way from the ration provided was sufficient for their bodily requirements, and that the amount artifically supplied increased the quantity beyond what was demanded by nature. This was borne out to some extent by the fact that birds which refused to eat the morning mash containing iodine ate greedily, if given the opportunity to do so, the mash in which iodine was not included.

It may be mentioned that the pollard fed during the test came from Australia, the maize from South Africa, the wheat and bran from Canterbury, the meat-meal was produced in the North Island, the green food was grown at Wallaceville, while the oyster-shell consumed came from the bottom of the sea at the Bluft. In view of the different localities in which the ingredients of the ration were produced, it would no doubt have been a remarkable coincidence had the food and oyster-shell provided not contained the amount of iodine necessary to satisfy the birds according to the dictates of instinct.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Preparations for Winter.

As the off-season is approached, and before the weather breaks for winter, it is essential to make the hives as snug as possible. New Zealand has its season which corresponds with the winter months in colder climates, when breeding almost ceases and food is scarce or entirely absent in the fields. Every effort should therefore be made to conserve the natural warmth of the bees. As indicated last month, mats are essential, and each hive should have at least two, and two spare ones, as occasionally dry mats are needed in exchange for damp ones. Good clean corn-sacks make the best mats. Cut the mats so that they exactly cover the frames, and on no account allow them to extend beyond the walls of the hive, or they will become wet and cause dampness, thus endangering the health of the bees.

Removal of Spare Supers.

All supers not occupied by the bees should be removed preparatory to making the hives as snug as possible. A strong colony with a good queen at this time will need its brood-chamber and at least a super, and these will be fairly crowded with bees, most of them bred since the close of the working season. These are the colonies which one should strive to have at this season of the year, as they will come out strong in the spring and give the best returns when the main honey-flow sets in. As robber bees are likely to become troublesome when removing the supers, the best and safest plan is to use bee-escapes, for it will be found that quite a lot of bees must be got rid of before the supers can be removed. By placing the escapes on the hives in the evening the supers will be clear of bees in the morning, providing that is no brood in the combs. If escapes are not used all hive-manipulations should be carried out expeditiously and as early in the day as is convenient.

Spare Combs.

In the absence of a proper comb-room, or any convenient place for storing the combs to keep them clean from the wax-moth and vermin,

they, with the supers, may be placed on the hives after confining the bees below with close-fitting mats. As a temporary means of protecting combs this plan serves the purpose. However, it is not a good one for preserving the combs for any length of time during the winter months, as there is a danger of the combs becoming mouldy. This will occur sooner or later in supers from which the bees are entirely shut out.

—*E. A. Earp, Senior Apiary Instructor, Wellington*

HORTICULTURE.

Vegetable Crops.

At the request of a grower, who stated that his crop of vegetable marrows was attacked by disease, an inspection was made during the early autumn. The crop was found to cover about half an acre, was fully grown, and well set with " fruit." It had evidently been a most promising crop, but when visited three parts were completely enveloped in powdery mildew fungus and a small portion had quite withered up. No marrows had been grown on the farm for three years, and on the area in question no marrows had been grown for five years. A sample was taken for examination, and the subsequent report stated: " These leaves are infected with powdery mildew due to the fungus *Erysiphe cichoracearum*. This attacks a great number of plants, and could readily spread from these to marrows. It may be combated readily by one or more applications of colloidal sulphur (2–100)." Fungi of this genus are commonly found attacking herbaceous plants in the garden; delphiniums are very subject to the trouble, and it is useful to know that a liquid sulphur spray will prevent its spread. If a strange disease makes its appearance in a crop, growers should send in a sample at once to the the Director, Horticulture Division, Department of Agriculture, Wellington, and see if anything can be done about it. Prompt attention in the foregoing instance would have saved a valuable crop.

Potatoes, onions, and other produce in storage should be carefully examined at regular intervals, and they should be given the necessary attention. Conditions may easily become too dry for the satisfactory storage of potatoes or too moist for onions; ventilation also must be attended to. With these attentions there is little trouble in keeping these products in good condition throughout the winter if they are firm, sound, and clean to begin with. More often they are of a mixed class and require a lot of handling to sort out waste. This work, waste, and contamination of the premises could be avoided if the crop were graded for soundness at the first handling.

In preparation for the spring-time planting and sowing, ploughing and cultivation should be completed now as soon as weather permits the soil to be sufficiently dry for working. It then has time to consolidate, organic material to decay, and weed seeds to sprout and be destroyed. It is a great advantage for this to take place before planting or sowing the crop, more especially during the spring-time. A generous dressing of organic manure turned under now is generally desirable, even if it is only bonedust. On light land one can hardly be too generous; on heavy land that is well-drained a good dressing may be given, but if such land is moist and the drainage rather inefficient, an excessive application of humus may do serious harm. The mistake, however, is rarely made except on small areas.

For permanent crops such as asparagus and rhubarb, which are planted about the month of August, a rich deep, clean tilth is particularly

necessary. But for root crops and tomatoes, dressings of farm manure turned in before sowing produce coarse roots and plants that are undesirable. For these the humus must be perfectly assimilated by applying it before a previous crop. Most other crops require good treatment in this respect, and for celery it is essential.

Crops of spring cabbage and cauliflower will now be established, and light cultivation during dry intervals will be necessary to suppress weeds. Any gaps made by plants failing should be filled.

Pruning of Bush Fruits.

In the successful cropping of bush fruits good pruning at the proper season is perhaps the most important factor. Where suckers are allowed to grow up from the base of gooseberry plants, and rank growth fill the centre of the bushes, a quantity of small late fruit difficult to gather is the best one can expect. The result is very similar where other kinds are neglected. Heavy crops of good quality can only be grown where the growth is intelligently regulated. Much of this is best done in the summer so soon as the crop is gathered ; the energies of the plant are then directed into the proper channels instead of being wasted. However, pruning treatment should be considered now, and where it has been neglected in summer it will now be heavy ; but if good crops are expected this operation when performed with patience and intelligence will do more than anything else to secure it. Apart from a few commercial growers it is rare to see these crops in good condition, which is unfortunate, as for preserves and summer use they are important.

In the case of gooseberries, remove now completely rank growth frequently found crowding the centre of the bushes, also suckers about the base. It is only making matters worse to cut them back ; they must be removed completely. The work is then completed by cutting back wood that fruited last season to the bud at the base, treating last year's growth that is weak in a similar manner. It is the strong young last year's wood that is left which will carry the crop of the coming season, which will be of good size, abundant and easily gathered if other conditions are right.

In the case of black currants, which grow so well on good land in the cooler districts, the best fruit and most of it is produced on strong young wood made during the last season ; even the suckers are fruitful. It follows then that the wood which fruited last year can be dispensed with ; it should be cut back to just above the lowest bud. This plant does not demand the sunshine and light to the extent that others do, and an open centre is unnecessary. Where this pruning treatment has been neglected in the past, and the wood is of a nondescript type, these instructions are not easily applied, but the wood should be well thinned out, and the character of the plants will improve in a way that will soon make pruning easier in the future.

With raspberries and loganberries it is important that the fruit-bearing wood should be removed so soon as the crop is gathered, and all weak shoots from the ground suppressed. If that has not been done it should be done now, cutting the canes away at the surface of the ground.

When pruning is completed apply a spray of winter strength bordeaux and turn under a green crop, or a dressing of well-decayed farm manure or fowl manure in a friable state. It is important that this cultivation should be very shallow, or serious damage will be done to the fibrous roots.

Sowing for the Indoor Tomato Crop.

For the indoor crop of tomatoes the seeds should be sown now. It is of first importance that a suitable variety and strain should be chosen. It is very common to find crops deficient in this respect that no amount of after-attention will remedy.

The seeds are best raised in a heated glasshouse, but a hotbed is suitable if it is properly made. This bed is sometimes made up in a large house in which tomatoes are to be grown, although it is somewhat in the way of cultivation there. A hotbed should be made of fresh stable manure, but it is not uncommon to see them made up without any preparation. A steady heat over a long period cannot be obtained in that way. If it is turned over, shaken out, and firmly restacked two or three times at intervals of a few days, the improved results will be found well worth the trouble. When turning it all dry parts should be sprinkled with water. The final result is that bacterial action, causing fermentation, is active throughout the mass, and maximum results are obtained. Where stable manure is scarce, fallen leaves from deciduous trees are useful to supplement the supply.

Sow the seeds in boxes containing a good loam moderately rich, and with sufficient sand to keep it open; no chemical fertilizers are needed. A temperature of 55° to 65° F. is required for satisfactory germination. If the hotbed is outside see that good covers are ready to protect the frames in frosty weather. A humid atmosphere and high temperatures are the dangers that are most likely to do harm. Apply tepid water moderately during the morning, as required, but use it sparingly. Ventilate freely in fine weather, and close the frames in the afternoon before the outside temperature commences to fall. If these rules are maintained, sturdy plants are grown which will lose no time in doing what is expected of them.

The glasshouse in which they are to be planted should now be thoroughly clean, and a strong green crop growing with plenty of ventilation. This crop must very soon be turned in so that it may thoroughly decay before the time arrives for planting out. This decay is assisted by having the land thoroughly moist. It is quite usual to find the land in these houses far too dry at this season of the year; it should be thoroughly soaked so that little water need be applied for some time after the tomato plants are put out, and the danger of chilling them will be greatly lessened.

The Homestead Garden.

Hardy shrubs should now be pruned. Where growth is crowded it should be thinned out by complete removal of unnecessary wood—that is, it should be cut away close up to the point of issue; by admitting an abundance of light and air the branches are kept furnished with foliage and flowers. Where more growth is needed it may be obtained by cutting away now from young growth one-half to two-thirds its length. This has a most invigorating effect on the part so treated. Climbers especially should be kept well in hand by proper pruning in winter and summer as may be necessary. The luxury of seeing well-trained wistarias, begonias, &c., in flower might easily be much more common under the great advantages of climate which we enjoy. Shrubs flower usually on (1) short thick growths that are called spurs; (2) young wood of last year's growth; or (3) new wood. In each case the fact should be ascertained, and it is the main one to be borne in mind when pruning.

Established shrubberies would be greatly benefited now by a generous mulch of decayed farm manure. It can be lightly forked in, but deep digging should be avoided. The front of these borders is very commonly used for herbaceous planting, but this is not generally a suitable arrangement. Most of the popular plants of that kind require rich ground that is well trenched every three or four years, and so their interests clash very seriously with that of the shrubs. The foreground is better planted with some of the dwarfer shrubs such as the veronicas, hydrangeas, fuchsias, &c., or, if herbaceous planting must be done, the choice should be limited to those kinds which enjoy the environment the shrubs afford.

—*W. C. Hyde, Horticulturist, Wellington.*

WEATHER RECORDS: APRIL, 1932.

Dominion Meteorological Office.

THE principal characteristics of the weather in April were mild and humid conditions and an absence of wind.

Rainfall.—Rain was below normal in parts of the Bay of Plenty area, in all of Wellington except the eastern coastal portion, and in much of Nelson and the West Coast of the South Island Elsewhere there was an excess, which in many cases was considerable. Even when there was no rain, much of the weather was damp and, in the North Island especially, showers were frequent.

Temperature.—After a prolonged period with temperatures in nearly every month below normal, it is pleasing to record that April was almost everywhere somewhat warmer than the average. This was most noticeable in the interior of the North Island. A few frosts were recorded, but they were not severe, and vegetation was practically undamaged. The high ranges received a few light falls of snow.

Wind.—The absence of wind was one of the most pleasing features of the weather. There were very few strong northerly winds, and southerlies generally prevailed. A strong north-easterly gale blew in the North on the 27th and 28th

Sunshine.—There was more cloud than usual, and sunshine was in consequence considerably below the average. There were, however, some very fine days.

Pressure Systems.—Intense anticyclones were a feature of the weather charts, the pressure exceeding 30·4 in. on several occasions.

Rain was widespread on the 4th and 5th, with heavy falls in the North, when a rather irregular westerly depression crossed the Dominion.

The next rainy period culminated on the 10th, when a shallow cyclone crossed the South Island. Rain was practically general, with many heavy falls. On this occasion there were some very heavy rains in Canterbury and Otago.

A series of westerly depressions passing between the 20th and 23rd brought rains to districts with a westerly aspect.

The most notable storm of the month, however, was one which began as a severe tropical cyclone in the New Hebrides on the 25th. This cyclone moved in a south-south-easterly direction, and on the 28th had reached the neighbourhood of Cape Maria van Diemen. Thence it passed slowly down the east coast. Heavy rain began in the far North on the 27th and extended southwards, conditions being still unsettled at the end of the month. In North Auckland the falls were very heavy on the 27th and there was some flooding. On the 28th and 29th the area of heaviest rain had moved to Hawke's Bay, and most of the rivers in that Province were in high flood. At Anawai, near Havelock North, 9·47 in. was recorded on the 29th, and many places had over 4 in. in twenty-four hours. Considerable damage was done by the floods, but ample warning had been given, and at a critical stage the rain moderated. Marlborough and North Canterbury also experienced heavy rains during this period, and few places escaped altogether.

Feeding Sheep on Potatoes.—In the Willowbridge district of Canterbury last winter, owing to unpayable market prices for potatoes, the tubers were extensively used for feeding sheep. In some cases they were merely ploughed up and the sheep turned in on them.

RAINFALL FOR APRIL, 1932, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average April Rainfall.
	North Island.				
		Inches.		Inches.	Inches.
1	Kaitaia	6·03	9	2·72	4·31
2	Russell	5·75	9	2·15	4·14
3	Whangarei	3·41	14	2·22	5·00
4	Auckland	4·05	17	1·21	3·54
5	Hamilton	4·24	16	1·50	3·84
6	Rotorua	4·08	16	1·01	4·52
7	Kawhia	4·89	17	1·70	4·65
8	New Plymouth	7·40	17	1·83	4·54
9	Riversdale, Inglewood ..	9·24	16	1·72	8·08
10	Whangamomona	7·71	11	1·80	6·47
11	Eltham	5·28	16	0·92	5·21
12	Tairua	6·31	14	1·35	5·94
13	Tauranga	7·88	16	2·26	4·68
14	Maraehako Station, Opotiki	3·15	17	0·56	4·83
15	Gisborne	5·07	13	3·10	4·04
16	Taupo	4·20	17	1·21	3·57
17	Napier	2·94	12	1·15	2·78
18	Hastings	3·63	10	1·43	3·32
19	Taihape	2·71	17	0·69	2·79
20	Masterton	1·62	10	0·44	3·08
21	Patea	3·46	11	1·04	3·67
22	Wanganui	2·70	12	0·99	3·28
23	Foxton	2·00	10	0·62	2·53
24	Wellington	2·69	15	0·62	3·53
	South Island.				
25	Westport	7·94	15	1·45	8·35
26	Greymouth	8·33	14	2·45	8·46
27	Hokitika	11·67	16	2·30	9·29
28	Ross	15·54	11	4·40	12·03
29	Arthur's Pass	12·78	10	3·53	15·59
30	Okuru	12·15	11	2·00	14·14
31	Collingwood	8·34	16	1·31	8·13
32	Nelson	1·89	12	0·37	2·99
33	Spring Creek	2·83	11	1·10	2·09
34	Hanmer Springs	3·73	11	1·17	3·30
35	Highfield, Waiau	3·45	8	1·30	2·71
36	Gore Bay	3·22	7	1·30	2·33
37	Christchurch	1·52	11	0·73	1·85
38	Timaru	4·26	9	2·00	1·52
39	Lambrook Station, Fairlie ..	3·30	9	1·71	1·94
40	Benmore Station, Clearburn	2·78	12	0·93	2·39
41	Oamaru	3·57	8	1·91	1·76
42	Queenstown	2·98	11	1·04	2·98
43	Clyde	2·55	8	1·47	1·42
44	Dunedin..	4·63	13	2·35	2·74
45	Wendon	3·25	10	1·20	2·67
46	Gore	..	..	..	3·12
47	Invercargill	4·16	16	1·00	4·14
48	Puysegur Point	6·19	15	1·60	7·75
49	Half-moon Bay	4·12	14	0·77	5·16

Control of Wing Thistle by Sodium Chlorate.—Trials in Hawke's Bay indicate that a 2½ to 5 per cent. solution of sodium chlorate will kill out wing thistle.

THE LATE STENHOUSE WILLIAMS: AN APPRECIATION.

THE death occurred on 2nd February last of Dr. R. Stenhouse Williams, Director of the National Institute for Research in Dairying, Shinfield, and Research Professor in Dairy Bacteriology at the University of Reading, England.

When the National Institute was first established in 1912, and provided with humble quarters in the attic of a private dwelling, it was Dr. Williams's success in public-health bacteriology that led to his appointment. During all his dairy work he always maintained the viewpoint that the health of the nation could be immensely improved by encouraging the consumption of more and more milk which had been obtained under clean and sanitary conditions from healthy cattle. Apart from the fact that the sale of more milk would benefit the farmers who thereby earned their living, he maintained that the elimination of diseased cattle from the herds would at the same time avoid losses of a magnitude quite unrealized by the farming community. Progress towards his ideal was at first slow, but his appreciation of the difficulties besetting the dairy-farmers enabled him to enlist their co-operation in increasing numbers. He lived to see carried out immense improvements both in the handling of milk and in the health of dairy cattle in England.

Figures compiled some years ago showed that in England the value of the fluid milk trade amounted to about £50,000,000 annually, in addition to some £10,000,000 worth of milk manufactured into butter and cheese. In spite of the effort required to study the problems of an industry of this magnitude Dr. Williams found time to devote to the dairy problems of distant parts of the Empire, where information about the latest discoveries is frequently difficult to obtain. To assist in the local application of knowledge already available and to avoid wasteful duplication of expensive researches, the Empire Marketing Board a few years ago provided funds to establish under his able editorship the *Journal of Dairy Research*—the first journal in the Empire devoted solely to the scientific side of the dairy industry. As a pioneer in the clean-milk movement he achieved a world-wide reputation, and his unique experience and comprehensive knowledge gave special importance to his writings.

Dr. Williams was a man of untiring energy, who never spared himself in the discharge of the duties which devolved upon him, nor could he be persuaded from the narrow path which he believed to be his duty. Short cuts of any description were anathema to him, for he took a pride in doing things thoroughly and inspired others to do likewise.

He leaves two great memorials—a great Imperial industry guided to higher standards, and a valuable National Institute for Research in Dairying which grew to its present position under the wonderful spirit of loyalty which he inspired in a band of enthusiastic co-workers.

—*G. M. Moir, Wallaceville Laboratory, Wellington.*

PRICE OF STRYCHNINE FOR RABBIT POISONING.

OWING to the increased cost of supplies the Department of Agriculture has found it necessary to increase the price of alkaloid powdered strychnine from 3s. 3d. per ounce to 4s. per ounce. Case lots containing 100 oz are obtainable at 3s. 6d. per ounce.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

FEEDING SILAGE TO BREEDING-EWES.

H. K. RENDELL, Kiwitahi :—

In feeding silage to breeding-ewes what weight per day should be given to sheep started in a good store condition? Would it be better to finish feeding just before lambing starts, or to commence feeding later and feed until lambing was well through—say, towards end of August—and working the ewes out as they lamb?

The Live-stock Division :—

The amount of silage to be fed depends on the condition of the pasture. If this is very bare you could feed up to 5 lb. per day, but if there is a fair amount of feed then 2 lb. to 3 lb. per day would do. In this *Journal* for October, 1930, was published the opinion and experience gained by a number of farmers who had tried out feeding silage to ewes. Sheep do not care for the stemmy silage of poor quality, but cattle will eat this with impunity. By making silage for sheep one is able to keep the pasture in a much better condition for sheep-feeding. The best time to cut is just when the grass is getting into bloom, and the aftermath then comes away rapidly. With regard to the feeding of silage, you would probably not lose anything by feeding right through into September. Practical farmers have fed silage with most satisfactory results for several years.

MANURING FOR POTATO CROP.

"INQUIRER," Marton :—

Would the contents of a three-year-old haystack, rotted through rain, be of any value as regards manure for a potato crop? I intended spreading the contents of the stack on to a grass field, and ploughing deeply in June for planting in late August. The soil is of a light nature and suitable for potato-growing. Would sheep manure from a wool-shed night-pen, and applied in the same manner as the hay, be more suitable for potatoes?

The Fields Division :—

Well-rotted hay is valuable as a partial manuring of potatoes, and specially when incorporated with light soils of low humus content, inasmuch that nitrification is assisted, and the ammonifying power of the soil increased. It must not be regarded as a complete manure, the inclusion of a phosphatic fertilizer being essential to the growth of potatoes. The action of sheep-manure from a wool-shed night-pen produces a similar effect, but, owing to its high nitrogen content, should be used sparingly when manuring for potatoes. A heavy application of sheep-manure will bring about excessively rapid growth, which is detrimental to the potato, and the resultant crop is liable to contain a large number of hollow-heart tubers.

REMOVAL OF FRUIT-TREES.

"ORCHARD," Waitomo Caves :—

I desire to remove trees, some having been planted out for four years, others three years. They are mainly apple, pear, peach, cherry, nectarine, plum, lemon, and orange. Would you please advise me the most desirable time to remove same, also the surest method to adopt?

The Horticulture Division :—

The citrus and deciduous fruit-trees mentioned may be removed while in a dormant state. The work should be done when the soil is dry, and holes prepared so that replanting may be done as soon as possible, so avoiding exposure of the roots

to drying winds. Lift the trees carefully with a large ball of soil, and wrap them securely with hessian to avoid damage in transit. Large trees are generally best carried on a sledge. Prune the trees rather severely and paint the larger wounds that may be made. Leave the citrus-trees until the last; early in September will be soon enough for their removal. Should dry weather follow, mulch the surface of the ground over the roots.

LIME FOR POULTRY AND CATTLE.

"AMATEUR," Pukekohe:—

Would you kindly advise me if it is good policy to put lime in the fowls' drinking water all the year round, and, if so, how much should be used per gallon, and what kind of lime? Would burnt shell lime do? Would putting lime in the water also be good for cattle?

The Live-stock Division:—

Fowls need lime for bodily requirements and for the making of egg-shells, but no one can gauge an individual bird's requirements for these purposes. By adding lime to the drinking water throughout the year a bird might easily be compelled to consume more lime than is good for it. The best means of providing the lime is to have ample broken oyster or other sea-shell available where the birds can pick at it as they choose, and thus secure the quantity necessary to satisfy the demand of nature. Where lime is required by cattle it can be given in the form of slaked lime put in the drinking troughs, or by feeding a mixture of bonemeal and coarse salt in equal parts. This lick should be put in boxes and placed where the stock have daily access to it.

STINKING CAMOMILE IN PASTURE.

"INQUIRER," Whakapara:—

I have a paddock carrying good grass and clover which I do not wish to plough, and which has in places what they call "stinking caramel." Is this plant harmful to stock, and, if so, what is the best means of getting rid of same?

The Fields Division:—

The plant in your pastures is probably *Anthemis cotula*, known as stinking camomile or stinking mayweed, an erect branched annual of the daisy family, distinguished from several other similar weeds by the strong, disagreeable smell produced when the flower heads are bruised. Stock will not eat it on account of the unpleasant taste. Since it is an annual, re-establishment each year in a pasture is entirely dependent on reseeding. It is best eradicated, therefore, by hand pulling and burning if scattered, or by mowing to prevent flowering if plentiful.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 24th March to 5th May, 1932, include the following of agricultural interest:—

No. 66414: Harrow; C. F. Bennett. No. 67292: Milking machinery; D. MacMillan. No. 65906: Weed-killing device; C. F. Turner. No. 66006: Milk-can trolly; C. Swanson. No. 66079: Sprayer; C. M. Brown. No. 66408: Foot-piece for wooden posts. No. 66940: Cultivator; W. A. Abbott, L. D. Abbott, and T. Thomassen. No. 66941: Plough; W. A. Abbott, L. D. Abbott, and T. Thomassen. No. 67185: Apparatus for castrating animals; Daroux Emasculators, Ltd. No. 68020: Fungicide; Grasselli Chemical Co. No. 66617: Treatment of flax; W. E. Langguth. No. 66688: Silo; W. C. England. No. 66727: Tool for extracting honey; J. C. Clark. No. 67001: Grading of fruit; E. H. T. Bensemann. No. 67862: Milking-machine; L. F. Ellery. No. 67687: Lamb marking and operating cradle; J. Y. Shannon. No. 68574: Tine harrow; E. C. Bellve.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

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CONTROL OF BUSH SICKNESS IN SHEEP.

THE ATIAMURI EXPERIMENT WITH IRON LICKS.

B. C. ASTON, Chief Chemist, Department of Agriculture.

IN the *Journal* for March last was given a brief interim account of an outstanding experiment, conducted at Messrs. Hill and Sons' Atiamuri Station, for the control of bush sickness in sheep by means of iron licks. The experiment was carried on for a further few weeks, and the strikingly successful result obtained from the limonite treatment now calls for a full record of the undertaking.

As in the case of other co-operative experimental work with farmers in the bush-sick districts, the results at Atiamuri were attained with a minimum of surveillance by Government officers. The plan, once decided upon, was carried out by the station manager and his assistant with only that amount of superintendence which Mr. C. R. Taylor, analyst's assistant, stationed at Rotorua some twenty miles away, could give during his periodical visits, which had to be restricted as much as possible owing to the desire to save travelling-expenses. Any idea that this experiment was of the nature of a State or fertilizer company's farm demonstration, and therefore might possibly be considered by farmers as having been conducted in a manner which they could not afford to follow in actual practice, must not be for a moment entertained. Further, the whole expense of the experiment, including the cost of losses on the control or untreated group of animals, in which the mortality of ewes and lambs was only that expected to occur, was borne by the owners of the run.

To Mr. Taylor a very large share of the credit for the success is due. Once the desirableness of having a thorough test of limonite treatment of sheep was decided upon by the writer, the whole matter was left in his hands to arrange with a suitable farmer. The scheme of work was therefore settled by him in consultation with the manager of the station, Mr. T. V. Humphrey.

FORMS OF IRON USED.

Towards the end of 1930 it was becoming increasingly evident that the supply of spathic iron ore was likely to be insufficient and too costly to supply the needs of farmers desiring a cheap, efficacious iron lick for stock. It was thought from theoretical considerations, and

also remembering the success which had attended the use of iron oxide and salt lick with cattle in the Kenya experiments conducted by the Rowett Institute, that it was advisable to try how far this experience with cattle could be extended to sheep. It was not known which particular iron oxide was used in Kenya, but it was assumed—somewhat hastily it seems—that Scotch bog iron, an impure limonite, was the form. However, this now turns out to be erroneous; the material actually used in Kenya was hæmatite, an oxide of iron which differs considerably from limonite in the water of constitution content. The experiments started in May, 1931, are therefore the first, so far as is known, that have been attempted using limonite as the iron remedy in a lick, and thus the New Zealand Department of Agriculture is entitled to the credit of first using a compound which may prove to be more suitable than the more insoluble hæmatite. In a circular to users of iron ammonium citrate in the bush-sickness districts, issued on 20th May, 1931, for the purpose of securing as many tests as possible, the writer mentioned limonite in the following paragraph:—

> As an alternative to this particular form of iron (the native carbonate), which is extremely hard and difficult to grind, there is yet another local iron ore, which is found in softer form and is more valuable commercially. This is the *hydrated oxide known as limonite*, which is used in fairly coarse condition as a purifier for coal-gas. This is, therefore, already on the market, and when mixed with salt may prove efficacious in the prevention and cure of bush sickness.

Mr. Taylor (who since October, 1929, has been in charge of the farmers' experiments in the Rotorua districts, which were being conducted apart from those carried out at the Mamaku Demonstration Farm under different management) was instructed at the end of February, 1931, that in order to cope with the difficulty of obtaining a supply of material from New Zealand sources for making an iron lick it was desirable for him to arrange a parallel experiment using carbonate in one, and hydrated oxide (limonite) in another. It was further mentioned that the Onekaka oxide, of which a supply was stored at Mamaku, could also be tested; also that if a test at the same time could be made with the iron ammonium citrate it would make the information obtained all the more complete. It was found, however, that the Onekaka iron was too gritty* to be palatable to sheep, and the experiments were started in May, 1931, in pursuance of the following scheme, which had been agreed to tentatively in March.

From the Atiamuri Station flock 200 ewes were selected and divided into four lots each containing fifty, each group to be grazed and treated exactly alike except for access to the following licks:—

No. 1, control, had no lick.†

No. 2 had access to a lick containing iron ammonium citrate and salt.

No. 3 had access to a lick containing hydrated iron oxide (Whangarei limonite) and salt.

No. 4 had access to a lick containing native iron carbonate (Huntly spathic iron ore) and salt.

(No. 4 experiment was discontinued; see March *Journal*, p. 194.)

Twelve ewes in each group were weighed periodically throughout the term of the experiment.

* Onekaka iron is now obtainable from the works, Golden Bay, Nelson, in a form fine enough for use as a stock lick.

† In previous years rock salt or iodized salt had both been supplied without overcoming the malnutrition.

In June Mr. Taylor also was advised that "any great demand on iron carbonate could not at present be met, so that the limonite experiments should be pushed on, as there are unlimited quantities of that material available, and it contains twice as much iron as the carbonate." In the meantime the matter had been taken up with Messrs. Reyburn and Co., Whangarei, the owners of a deposit of limonite, and in August Mr. Taylor was advised that this firm would supply farmers for cash with material of approved fineness at a cost, f.o.r., of £5 10s. per ton for quantities of ½ ton or over, and for lesser quantities at 6s. per cwt. The firm also promised to erect suitable machinery for producing a very fine product as soon as the demand warranted the outlay. Messrs. Reyburn, who had already a well-established trade in supplying gas companies with coarsely ground limonite, were informed that the Department was seeking a suitable form of iron for use in the bush-sick areas. They then submitted a sample of the screened product which they were able to supply without installing special machinery. They were warned against employing artificial heat, and were asked to employ air-dried material in order to ensure that it was in as natural a state as possible so far as the solubility was concerned. The difficulties of drying, screening, and transporting the fine material were discussed, and trial lots were prepared for analysis at the Department's Chemical Laboratory. The results from Messrs. Reyburn's samples are given in Table 1 under Nos. A/1114 and 1115. Another firm, S. C. Crawford, Whangarei, also entered the trade in dealing with Whangarei limonite; analysis of a sample from this firm is given under No. B/976.

Table 1.—Analyses of Limonite Samples.

Sample No.	Date received.	Description.	Moisture at 100°C.	Loss on Ignition, including Water of Combination.	Insoluble Residue.	Sesquioxide of Iron (Fe_2O_3).
A/1114	12/3/31	Whangarei—unscreened	9·16	11·31	7·83	68·0
A/1115	12/3/31	Whangarei—screened	10·32	11·53	9·39	63·5
B/976	19/11/31	Whangarei ..	1·31	..	..	78·4
C/127	9/5/32	Onekaka ..	3·53	10·70	20·8	59·5

Fineness of Grinding.

	A/1114.	A/1115.	C/174.*	B/976.	C/127.
Retained on 2 mm. sieve ..	9·8	Trace	Trace	Trace	Trace.
,, 40 mesh sieve ..	67·8	18·6	3·8	Trace	Trace.
,, 60 ,, ..	3·3	15·4	19·4	Trace	Trace.
,, 80 ,, ..	2·4	11·7	15·0	Trace	Trace.
,, 100 ,, ..	1·9	7·1	13·2	6·5	6·0
,, 120 ,, ..	1·0	4·9	2·6	8·0	14·0
,, 150 ,, ..	1·3	4·4	5·6	13·0	
,, 200 ,, ..	1·7	7·1	5·0	16·5	8·0
Passed 200 mesh sieve ..	5·7	28·5	35·4	56·0	72·0

* Sample received from Reyburn's, Jan., 1932.

NOTE.—These analyses do not indicate which is the best material to use in making a salt lick for prevention of bush sickness. That can only be determined by a field experiment. The material used in the Atiamuri experiment is represented by sample A/1115.

From tentative experiments obtained with a ton of this limonite, Mr. Taylor reported in September that results from several selected farmers indicated that the limonite was likely to prove a good substitute for the carbonate, stores of which were now almost exhausted. It was necessary to postpone the issue of a circular which Mr. Taylor desired to send out advocating the use of carbonate of iron until it was seen whether the limonite could be relied upon to supplant the carbonate as a preventive for bush sickness. He stated, however, that in his own mind he felt confident that the limonite was capable of producing some very fine results. By this

FIG. I. STACK OF LIMONITE FOR GRINDING, AT REYBURN'S WORKS, RUATANGATA, WHANGAREI.

time Reyburn's were producing a very finely ground product, which Mr. Taylor was advised as a result of laboratory tests should suit admirably as a lick material. The section of this article which follows is largely his own wording.

LOCALITY AND FARMING PRACTICE.

Upper Atiamuri, where the experiment under review was located, is situated twenty miles south-west of Rotorua, and is roughly the centre of great areas of unimproved country capable of being brought into productivity at small expense and with every prospect of the settlers ultimately making good, especially with the knowledge gained from recent experimental work in the district. Messrs. Hill's property comprises 10,000 acres, two-thirds of which is ploughable, the balance being utilizable as a run-off to the improved areas.

As a general rule the flat country is poorer than the hill slopes, animals thriving better on the latter. Sheep becoming sick on the terraced rubbly pumice country frequently recover when removed to a hillside pasture. This may be ascribed partly to atmospheric

agencies removing the soft light Taupo pumice deposit from the steep faces into the valleys. A sticky brown clayey material underlies the surface soil on the hills but is absent on the flats. The natural vegetation is stunted monoao, bracken, manuka, and tussock. Of the workable country about half is elevated and half flat.

Farming on Hill's property first commenced in 1921 with cattle running on the rough country. Ploughing and grassing were started eight years ago, the usual method adopted being to grow turnips on the first furrow and the second year to disk and sow the grass with 2 cwt. of superphosphate per acre. Nearly 700 acres out of 10,000 have now been broken in in this way. Super at the rate of 2 cwt. per acre has been the top-dressing principally used since, but last year a large part of the farm received a mixture of super and slag (half-and-half) for the first time, a fertilizer which contains available iron in quantity.

Sheep have been carried for eight years, the breed favoured being Romney ewes and Romney rams. For the first year 250 ewes were obtained from Gisborne and Hawke's Bay, and these, wandering over a large range besides the few improved paddocks, did remarkably well; but since then with larger numbers confined more or less to the improved areas, the mortality among the grown sheep has reached at times the alarming rate of 20 per cent. Extensive feeding of turnips during the winter months, and the free use of iron carbonate as a lick for the past few years, has reduced the average death rate to 6 per cent. The mortality for the current year, during which a fair amount of limonite has been used, has not yet been determined, but it is safe to say, all things considered, it will not be very high. (Sheep records are made up annually to the end of June.)

Lambs have always been the main difficulty, and it has never been possible until this year to keep them after the end of January, except perhaps a few odd ones which do well all the time and ultimately make splendid sheep. In the majority of cases, however, lambs commenced to slip back during the months of December and January, necessitating their immediate removal from the property, and selling regardless of price offering. In this way it can readily be seen that it has not been possible to build up a flock of station-bred ewes, and each year it has meant buying in for replacement purposes, a usually rather expensive method in addition to being not so satisfactory. Fortunately the flock lambs this year on limonite lick have done, and still are doing, exceptionally well, and it is believed that they will grow into very fine sheep now that they have progressed so far.

The most important knowledge arising out of the 1930 experiment with iron carbonate was that sheep must first of all be in a healthy condition if they were to remain so on this compound; and, secondly, to be sure of getting good healthy lambs that were likely to do well it was imperative that the ewe should have the iron lick during the whole period she was carrying the lamb. *Good-looking* ewes that were given the carbonate lick for the first time a few weeks before lambing produced very miserable weedy lambs, while remaining, at least outwardly, in splendid condition themselves. Others of a similar type having access to the lick from March produced altogether different lambs, and moreover were able to do them better afterwards. This

point cannot be overstressed and is equally applicable to limonite treatment. Because a ewe *appears* to be in good health on this class of country without lick is no guarantee that she will produce a healthy lamb or be able to rear it properly. It is considered that the majority of lambs that appear to do well up to a point and then suddenly slip back do so because they are starved—the ewe has dried up just as a dairy cow will do when first affected by bush sickness, although she may look in other ways quite normal. During the past season in districts where cattle are affected many cows apparently in good condition gave birth to most weedy calves and then went completely to pieces themselves, necessitating in some instances many months of care and treatment to restore them to health again. All this could quite simply have been avoided if ordinary commonsense methods had been adopted from the first and farmers would only realize the actual cause of their troubles. If would appear that many of the parasitic troubles one meets with in the bush-sick districts in lambs, calves, &c., are due probably to the general low condition of affected animals, bush sickness making them favourable hosts to the further development of larval forms.

Progress of the Experiment.

Little or no difficulty was experienced in getting the sheep chosen for the experiment to take either the iron carbonate and salt lick or the limonite and salt lick, possibly owing to the absence of any characteristic flavour in these iron compounds and the fact that the sheep were accustomed to a plain salt lick prior to the commencement of the trial. Whenever difficulty has arisen it has *always* been very simply overcome by taking a few of the sheep to be treated or given lick and shutting them up in a very small area, such as a sheep-yard pen, and practically starving them for four or five days if necessary, with only a trough of lick and a few chopped up turnips, or a handful or so of grass thoroughly mixed up with it before them. The idea, of course, is to compel the sheep through starvation to eat the turnips or grass carrying the lick and so acquire a taste and liking for it. It has never been necessary to keep the animals penned for longer than five days, whether they appear to be taking the straight-out lick or not, so long as they have freely taken the turnips or grass. By then they have usually acquired a taste for the lick, know what it looks like, and are not afraid of the receptacle containing it. The trained sheep can now be put back with the rest of the flock, and they will educate the others into taking the lick. About six sheep per one hundred are all that are required for this purpose.

With regard to the actual feeding of the lick, it has been found that it is desirable to keep it as dry as possible, especially during the winter, as it is inclined to set rather hard on the surface and stock do not then take it in anything like the quantity necessary to keep them healthy. As a matter of fact, in the majority of cases it has been noticed that both sheep and cattle avoid it altogether in this condition, but once stirred up they partake of it quite readily again. With cattle, of course, it is almost an impossibility to feed lick to them in such a manner as will keep it dry, except in dummies in the cow-shed, but it is such a simple matter every three or four days, if necessary, or when happening to pass a lick trough in the course of

FIG. 2. LIMONITE-FED LAMBS IN THE ATIAMURI EXPERIMENT. PHOTO TAKEN 12TH APRIL, 1932.

Note size and good condition generally.

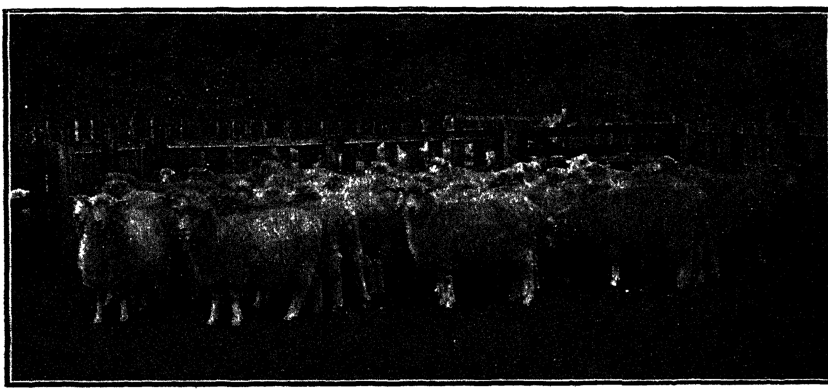


FIG. 3. LIMONITE-FED EWES, 12TH APRIL.

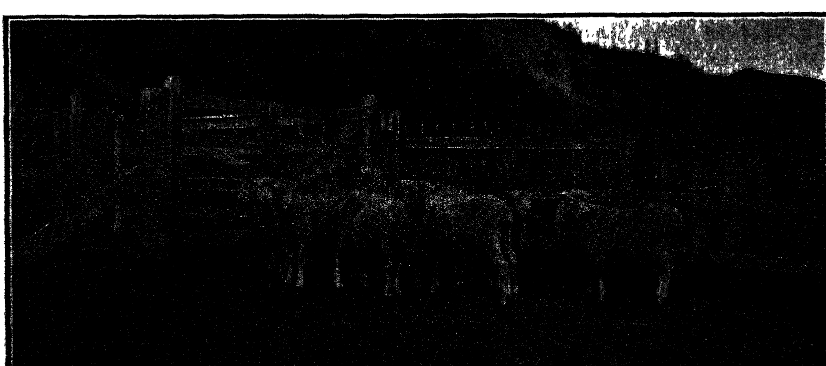


FIG. 4. SURVIVING CONTROL EWES (NO LICK), 12TH APRIL.

point cannot be overstressed and is equally applicable to limonite treatment. Because a ewe *appears* to be in good health on this class of country without lick is no guarantee that she will produce a healthy lamb or be able to rear it properly. It is considered that the majority of lambs that appear to do well up to a point and then suddenly slip back do so because they are starved—the ewe has dried up just as a dairy cow will do when first affected by bush sickness, although she may look in other ways quite normal. During the past season in districts where cattle are affected many cows apparently in good condition gave birth to most weedy calves and then went completely to pieces themselves, necessitating in some instances many months of care and treatment to restore them to health again. All this could quite simply have been avoided if ordinary common-sense methods had been adopted from the first and farmers would only realize the actual cause of their troubles. If would appear that many of the parasitic troubles one meets with in the bush-sick districts in lambs, calves, &c., are due probably to the general low condition of affected animals, bush sickness making them favourable hosts to the further development of larval forms.

Progress of the Experiment.

Little or no difficulty was experienced in getting the sheep chosen for the experiment to take either the iron carbonate and salt lick or the limonite and salt lick, possibly owing to the absence of any characteristic flavour in these iron compounds and the fact that the sheep were accustomed to a plain salt lick prior to the commencement of the trial. Whenever difficulty has arisen it has *always* been very simply overcome by taking a few of the sheep to be treated or given lick and shutting them up in a very small area, such as a sheep-yard pen, and practically starving them for four or five days if necessary, with only a trough of lick and a few chopped up turnips, or a handful or so of grass thoroughly mixed up with it before them. The idea, of course, is to compel the sheep through starvation to eat the turnips or grass carrying the lick and so acquire a taste and liking for it. It has never been necessary to keep the animals penned for longer than five days, whether they appear to be taking the straight-out lick or not, so long as they have freely taken the turnips or grass. By then they have usually acquired a taste for the lick, know what it looks like, and are not afraid of the receptacle containing it. The trained sheep can now be put back with the rest of the flock, and they will educate the others into taking the lick. About six sheep per one hundred are all that are required for this purpose.

With regard to the actual feeding of the lick, it has been found that it is desirable to keep it as dry as possible, especially during the winter, as it is inclined to set rather hard on the surface and stock do not then take it in anything like the quantity necessary to keep them healthy. As a matter of fact, in the majority of cases it has been noticed that both sheep and cattle avoid it altogether in this condition, but once stirred up they partake of it quite readily again. With cattle, of course, it is almost an impossibility to feed lick to them in such a manner as will keep it dry, except in dummies in the cow-shed, but it is such a simple matter every three or four days, if necessary, or when happening to pass a lick trough in the course of

FIG. 2. LIMONITE-FED LAMBS IN THE ATIAMURI EXPERIMENT. PHOTO TAKEN 12TH APRIL, 1932.

Note size and good condition generally.

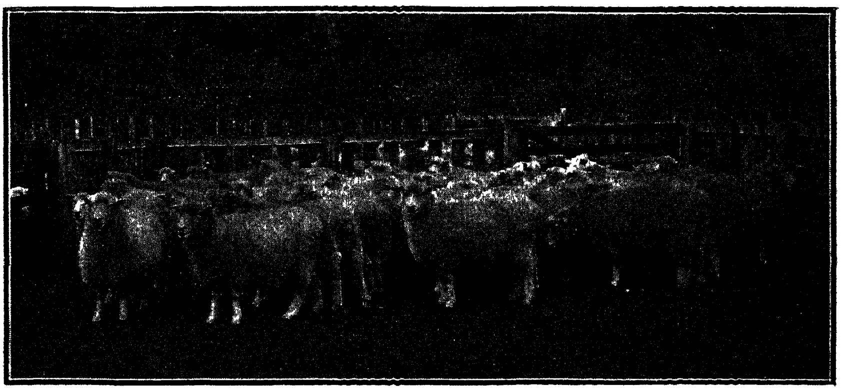


FIG. 3. LIMONITE-FED EWES, 12TH APRIL.

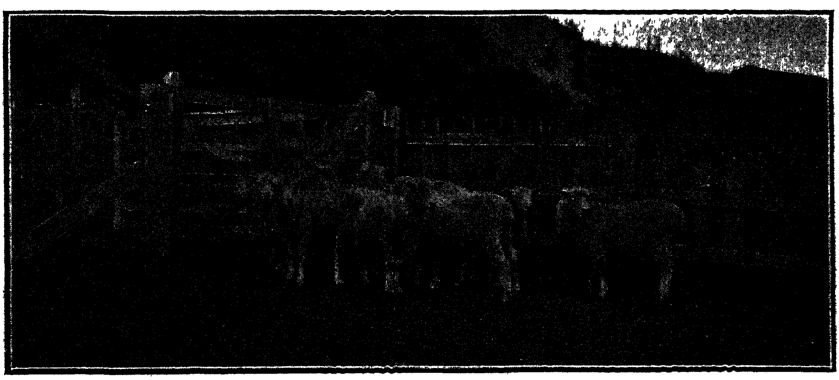


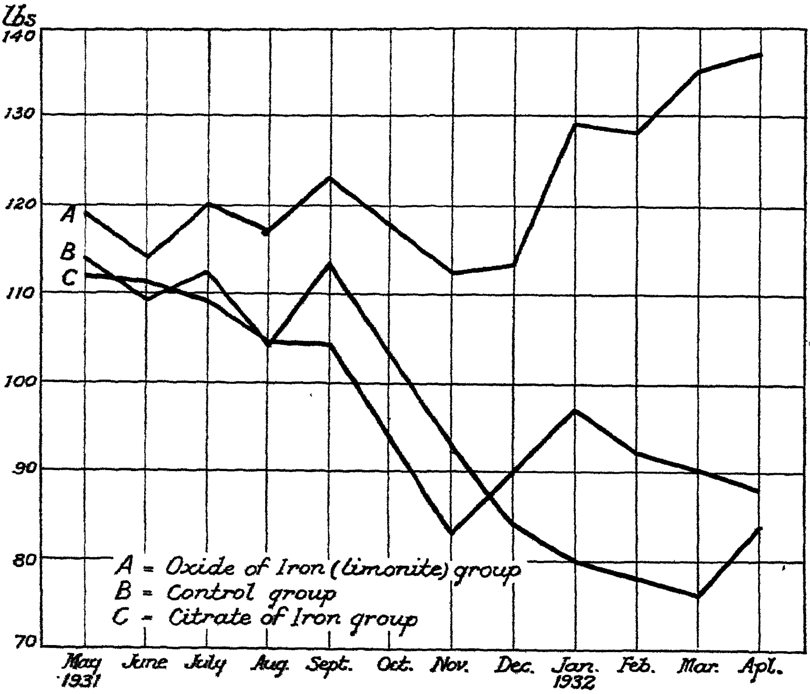
FIG. 4. SURVIVING CONTROL EWES (NO LICK), 12TH APRIL.

the daily round, to just give it a stir with a stick or pocket knife that no one need be afraid of the work being laborious or likely to occupy too much time. The results are worth it.

A trough similar to that illustrated in the *Journal* for April last, page 288, should be used for feeding the lick. Mr. Taylor has found the following methods best for feeding lick to stock, his remarks being quoted :—

"Carefully observe where the sheep congregate most, and place there a trough. In every paddock the sheep have a place where they camp of a night, and this makes an ideal site for a trough. If a paddock is flat to undulating the higher knobs will usually be found the favoured position. Slopes are usually preferred to valleys. In all cases common-sense is all that is required in the placing of troughs. It has been found that one trough to 20 acres, suitably placed, gives satisfactory results, but here again discretion must be used to make the most of local conditions.

"Dairy cows have done and are still doing well when fed a simple lick of limonite and salt (half-and-half) with or without molasses, but where little or no top-dressing has been done for a year or so it is an advantage to add 20 lb. to 30 lb. of steamed bone-flour to about 90 lb. of limonite-salt mixture. If practicable the best method of feeding lick to dairy cows is undoubtedly in bail boxes. They each get their share without molestation, and the farmer is at all times in a position to know the behaviour of every individual cow of his herd towards the lick, and can take appropriate measures to otherwise treat a beast which appears to require attention. Troughs of lick in various paddocks may also be put out with advantage."



GRAPH SHOWING AVERAGE NET WEIGHTS OF RESPECTIVE GROUPS OF EWES DURING CURRENCY OF ATIAMURI EXPERIMENT.

Concerning the graph of sheep weights, Mr. Taylor remarks :—

"It is most difficult to give a detailed explanation of all the slumps in weight as shown in graph. The big drop in October is undoubtedly due to lambing, while the further drop in November is due to shearing. After shearing it has always been noticed that sheep in moderate health put on weight for a time fairly rapidly, and this appears to explain the rise between November and January of the limonite and citrate groups—the sick controls still showing a drop in weight over the same period. February weights show a drop due to droughty conditions and scarcity of feed. The rise in weight of the control group from March to April is due to drenching with iron remedy in order to save further loss to the owners."

The live weights of the limonite-fed lambs in the experiment, as taken on 8th February, 1932, were as follows :—

No.	lb.	No.	lb.	No.	lb.	No.	lb.
(1)	95½	(12)	90	(23)	82½	(34)	84
(2)	86½	(13)	52	(24)	84	(35)	46
(3)	61½	(14)	94	(25)	70	(36)	81
(4)	83	(15)	68½	(26)	81	(37)	86½
(5)	95	(16)	72	(27)	61½	(38)	67½
(6)	91½	(17)	87	(28)	72	(39)	72½
(7)	101	(18)	60	(29)	66	(40)	78
(8)	81	(19)	79½	(30)	90½	(41)	71
(9)	66½	(20)	75½	(31)	56	(42)	68
(10)	64	(21)	89	(32)	66	(43)	53
(11)	85	(22)	78½	(33)	84	(44)	58

The live weights of the lambs from the other groups of ewes cannot be given, *as neither in the control nor in the citrate group did any lambs survive.*

A FIELD-DAY DEMONSTRATION.

A highly successful field-day was held at Hill's station on 20th February last, allowing many farmers from other bush-sick districts to inspect the results of the experiment. General satisfaction was expressed with the effect of the limonite treatment in enabling lambs to be reared. A post-mortem examination of a lamb in the limonite group of ewes, and of another lamb which had survived in the main mob and which had no access to any iron lick, was made on the spot by Mr. D. Marshall, Government Veterinarian from Hamilton. His report embodies his own findings and those of the Wallaceville Veterinary Laboratory, and is quoted as follows :—

Report on autopsies on two lambs from experiment with limonite lick at Hill and Sons farm, Upper Atiamuri, 20th February, 1932: I understand the two lambs were running over the same paddocks: A, from group getting limonite and salt lick; B, control (no lick).

A. Well woolled and well grown, dressed weight 44 lb. Plenty of fat on carcass, also on caul and round kidneys. Liver dark (healthy) colour, firm texture. Gall bladder well developed, kidneys large. Well-developed papillæ on lining of omasum (third stomach). Examinations of lining of abomasum and of small intestine for parasites were negative.

B. Poor lamb, short weak fleece, dressed weight estimated 15 lb. No internal or carcass fat, some excess of peritoneal fluid. Liver pale, friable; gall bladder small; kidneys small, cortex shade browner than normal. Poorly developed papillæ of lining of omasum. Examination for parasites showed these to be numerous, commonest being Ostertagia circumcincta and odd Hæmonchus contortus in abomasum, and Nematodius fillicollis in small intestine.

Size of organs no doubt related to total size of respective carcasses. Blood smears from each and samples were submitted to Wallaceville Laboratory, which reported the following results of examination :—

	Ca. Per Cent.	P. Per Cent.	Mg. Per Cent.	K. Per Cent.
A	11·6	6·2	2·1	37·9
B	10·4	6·2	1·9	31·9

Sample from "A" laked, and phosphate value probably higher than figures show.

Leucocyte count on slides.

	Polymorphs. Per Cent.	Lymphocytes. Per Cent.
A	13	87
B	57	43

To me, the absence of parasites in the limonite lamb, as compared with the other running on the same ground, is most interesting. Both were evidently exposed to infection by larval forms, and either the vermicide action of the salt and iron, or, what is more probable, the general thriving condition of "A" rendered it an unfavourable host for further development.

Limonite as a Cure.

It has generally been considered that insoluble iron compounds such as limonite would be of use only in the form of a lick as a preventive of bush sickness, but that where a cure was required it would be necessary to use iron and ammonium citrate as a drench. A recent experiment, however, indicates that successful results may be obtained with limonite as a drench. Details are given in Table 2, the figures representing live weights in each case :—

Table 2.

Limonite Drench *		Citrate Drench.†	
Weight before Treatment	Weight after Treatment.	Weight before Treatment.	Weight after Treatment.
23/3/32 lb.	12/4/32 lb.	23/3/32 lb.	12/4/32 lb.
(1) 52	70½	(1) 80	89
(2) 67	89	(2) 59	81
(3) 63½	81	(3) 56½	69
..	..	(4) 63½	80½

* Twelve drenches each of one level teaspoonful of limonite in 2 oz. water over period of twenty days.

† Twelve drenches each of 2 oz. 6-per-cent. solution over twenty days.

The few sheep treated culled out of the flock were so weak at the commencement of drenching that they could not stand. After the full twelve doses they had so much improved that they were able to stand up to dogging into the yards. The limonite-treated animals gained roughly 20 lb. each in weight in twenty days, and the citrate-treated 17 lb. each in the same period. The experiences of many of Tokoroa farmers and others who have tried limonite as a drench are in full agreement with these observations, and it is anticipated that limonite will ultimately replace iron ammonium citrate even for drenching purposes.

Analyses of Atiamuri Soils.

Analysis of soil-samples taken at Atiamuri show that the healthier soils contain more organic matter than the unhealthy ones. Detailed results are given in Tables 3 and 4.

Table 3.—Chemical Analysis of Atiamuri Soils.

(Results, except *, are percentages on soil dried at 100° C.)

Laboratory No.	Locality.	Volatile Matter.			Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method; Hall's Modification ("Available Plant-food").				Hydrochloric-acid Extract. ("Total Plant Food.")				Lime-requirement, $CaCO_3$.		Remarks.
		* On Air-drying.	* At 100° C.	On Ignition.		Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5	On Air-dried Soil.	On Soil dried at 100° C.	
	Hill's, Atiamuri.															
A/523	East Taupo, Block 3, B_2 T.C. ..	34·4	3·3	9·6	0·242	0·086	0·019	0·017	0·007	0·51	0·19	0·08	0·07	0·35	0·36	Healthiest but one.
A/525	" " 3, B_4 B L. ..	21·0	1·3	5·5	0·170	0·089	0·013	0·018	0·010	0·66	0·23	0·11	0·04	0·14	0·14	Sick.
A/527	" " 3, C_1 T.L. ..	34·5	1·6	8·7	0·221	0·071	0·012	0·015	0·006	0·13	0·15	0·07	0·07	0·27	0·27	Sick
A/529	" " 4, D_4 B.L. ..	37·1	2·6	10·5	0·268	0·093	0·022	0·015	0·010	0·54	0·19	0·08	0·08	0·35	0·36	Healthiest
A/531	" " 7, J_1 C.I. ..	39·5	1·5	8·2	0·188	0·069	0·016	0·012	0·006	0·55	0·18	0·08	0·09	0·22	0·22	Sick.

Table 4.—Mechanical Analysis.

(Results are percentages on air-dried soil.)

Laboratory No.	Description of Soil. (Classification of U.S. Dept. of Agriculture, modified.)	(Analysis of "Fine Earth" passing 2 mm. Sieve)								Stones and Gravel	Loss in Solution.	Remarks
		Fine Gravel.	Coarse Sand.	Fine Sand.	Silt.	Fine Silt.	Clay.	Moisture	Loss on Ignition.			
	Hill's, Atiamuri.											
A/523	Sandy silt (top) ..	5·3	21·2	20·1	24·2	11·3	1·7	3·3	9·4	7·1	4·3	Hill country. Cattle do well; cannot rear sheep.
A/524	Sandy silt (subsoil)	4·1	30·1	24·3	18·0	8·0	1·5	2 6	6·6	5·0	4 1	
A/525	Fine gravelly sand (top)	18·5	55·3	8·6	5·5	2·7	1·3	1 3	5 5	8 3	2·5	Stock sick; 20 ft. above stream terrace
A/526	Coarse sand (subsoil)	10·9	69·1	10·4	3·0	1·7	0·5	0 6	3·2	11·9	3·0	
A/527	Silt (top)	1·5	14·9	23·2	33·3	14·0	2·2	1·6	8 5	5·8	4 2	Cattle and sheep sick; terrace 200 ft
A/528	Silt (subsoil) ..	1·4	15·5	24·8	37·2	14·3	1·2	1·0	4·3	3·7	2·7	
A/529	Sandy silt (top) ..	4·6	23·4	19·7	23·2	11·0	2·5	2·6	7·2	6 7	1·5	Healthy country for cattle and sheep; well watered, underlain by sticky clay. Sheep recover when transferred here.
A/530	Coarse sandy silt (sub.)	10·5	33·0	18·0	18·0	8·5	1·7	1·7	6·1	10·8	3·8	
A/531	Sandy silt (top) ..	3·6	21·2	25·0	25·8	10·2	1·5	1 5	8·1	8·5	4·2	Terrace 100 ft. above Waikato; subsoil; coarse to considerable extent.
A/532	Sandy silt (subsoil)	5·4	28·6	22·3	24·5	8·3	1·2	0·9	4·2	9·3	3·6	Soil dry and friable.

Summarized Points.

A considerable advance has been made in the search for a rational and economic remedy for "bush sickness" in sheep; *rational* because some form of iron treatment is indicated as necessary by thirty years of experimenting in field and laboratory, and *economic* because the automatic administration of iron has hitherto been only successful on a small scale or by employing a costly meal containing the iron in the form of iron ammonium citrate.

The search for the right form of iron obtainable in nature in large enough quantities for the purpose has resulted in fixing upon the hydrated oxide of iron called "limonite" (Fe_2O_3 3 H_2O), a brown oxide which is much more soluble in acids than the non-hydrated red oxide, hæmatite (Fe_2O_3). There are inexhaustible quantities of limonite available in the North Auckland District, and other large deposits at Onekaka, Golden Bay, Nelson.

The limonite only requires to be ground extremely finely and mixed with an equal weight of salt to provide an efficient remedy not only for sheep, but also for cattle. If the limonite and salt are scattered on hay or ensilage when the stacks are built there is evidence that the remedy is equally efficient when consumed by stock in this way, so that a method of automatic administration is effected additional to the lick method.

With regard to the feeding of salt to stock, one may say that a fair consumption would be 1 oz. per week per sheep, and about seven times as much for a cattle beast—say, 1 oz. per day. If other materials are mixed with the salt, allowance must be made and the amounts of these added to the amount of salt fed.

These experiments must not be interpreted as throwing any doubt on the efficacy of iron ammonium citrate as a drench or otherwise given by hand to stock. It is now proved that it is inferior to the non-soluble limonite only when fed automatically as a lick to sheep, owing to their disinclination to consume it.

The treatment of the ewe with an iron lick before the lamb is born is regarded as essential to success on this country in raising lambs.

It will be noted from the chemical analyses (Table 3) that the healthiest soils have the highest "lime-requirement," a somewhat misleading term to denote the amount of lime that a soil will absorb in an empirical laboratory test without considering what the effects would be on a coarse highly ærated soil with a great or entire deficiency of colloids. These figures are highly significant in view of the oft-repeated experience that liming of pumice soils is dangerous, that alkaline manures are to be avoided, and that an acid reaction should be maintained in the soil. The hydrogen-ion figures for these soils range from 5·5 to 6·0.

The oxalic acid method suggested for determining the iron available in the soil also gives anomalous results at Atiamuri, the sick soils showing nearly twice as much iron as the healthy soils.

The use of iron sulphate mixed with fertilizer for top-dressing bush-sick pastures has long been advocated as the result of the Agriculture Department's experiments at Lichfield and elsewhere (see article in this *Journal* for December, 1928, entitled "Farming of Bush-sick Country," reissued separately as a leaflet). Fertilizer manufacturers are now acting on this advice, and experimenting with a fertilizer made from limonite and phosphate rock, which would result in a superphosphate containing soluble iron.

NEW ZEALAND PASTURE SEEDS.

WHAT THE DOMINION HAS TO OFFER.

(Concluded.)

E. BRUCE LEVY, Agrostologist, Plant Research Station, Department of Agriculture, Palmerston North.

(5) CERTIFIED NEW ZEALAND COCKSFOOT.

The New Zealand cocksfoot type is essentially a leafy grazing type, as distinct from the seed-production type represented in the Danish and American strains. It is highly persistent, leafy, dense at the crown, and is a moderately good winter grower, as compared with the winter-dormant Danish, Russian, German, Norwegian, and American types. It is not as fine in the leaf as the British indigenous type, or selections from these by Stapledon, Welsh Plant Breeding Station, now well established at the trial grounds in New Zealand. New Zealand cocksfoot is essentially the British indigenous "hay" type.

In a sense for high-production soils the "hay" type is preferable to the much lower-yielding, fine-leaved "pasture" type, which, while it may be excellent for low-production habitats in Great Britain, is too low-producing to warrant a place under conditions that permit of high production. Low-production cocksfoot strains, like low-production rye-grass, white clover, and red clover strains, may be excellent to keep in check such grasses as sweet vernal, brown-top, fine-leaved fescue, annual clovers, rib-grass, catsear, &c., and to help make a sward where ordinary cocksfoot fails; but, as before mentioned, potential high-production strains give greater scope in grassland production, and a good leafy type, such as the British indigenous hay type and New Zealand Akaroa type, is to be strongly recommended. This, at least, is true of New Zealand conditions, and I surmise that it would hold in all parts of the world where high-production grassland habitats abound.

Certified New Zealand cocksfoot is harvested from old pastures mainly about Akaroa, on Banks Peninsula, in the South Island. These areas were sown on bush burns in the early colonization period, and during the intervening time the Akaroa type has been evolved. Until the advent of Danish cocksfoot Akaroa was the main source of cocksfoot for New Zealand requirements and for export. The type has been disseminated to all parts, and it can be said that any old pasture stand in New Zealand is essentially the Akaroa type. Such stands are essentially the mother-seed producing areas, and crops from these after field inspection and plot trial are sealed as certified New Zealand cocksfoot—mother-seed standard. The product of crops sown down with certified mother seed after field inspection and trial represents certified New Zealand cocksfoot — permanent pasture standard—until these areas attain the age of five years, when they become eligible as mother-seed areas.

The Danish cocksfoot is a poor type from a grazing-pasture point of view, in quantity and quality of herbage and in persistence

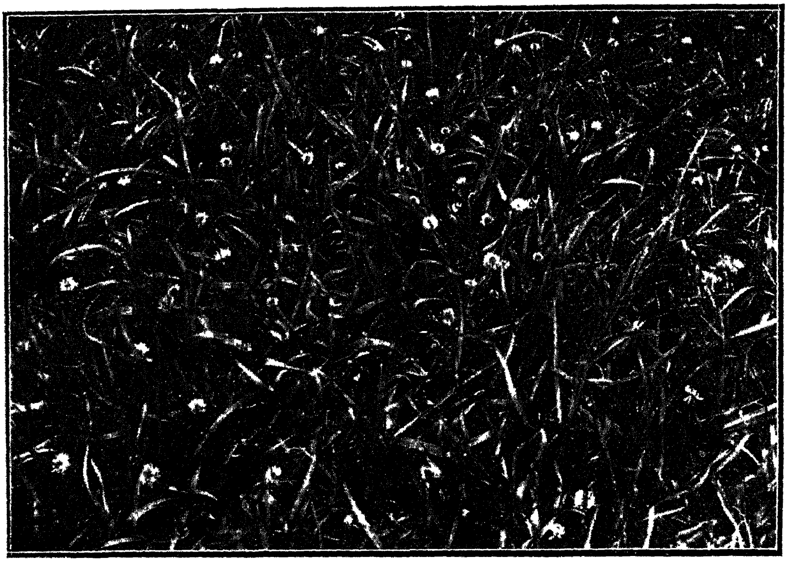


FIG. 7. SWARD OF NEW ZEALAND COCKSFOOT AND NEW ZEALAND ORDINARY WHITE CLOVER TYPE.

Under good pasture-management New Zealand cocksfoot swards in well with the other species of the pasture ; it persists well, and throws feed for a considerable period of the year

FIG. 8. TYPE OF HILL COUNTRY IN NEW ZEALAND WHERE CRESTED DOGSTAIL DOES WELL, PRODUCING GOOD WINTER AND EXCEPTIONALLY EARLY SPRING FEED.

under grazing. In New Zealand also it winter-burns badly at the first frost and remains comparatively winter-dormant until spring, and as soon as it starts growth in the spring it bolts away to seed. Some samples from America were even more stemmy and more highly seed-producing than the typical Danish forms, while lots from Germany, Austria, Russia, and Norway were similar to the Danish. It would appear from these and other overseas lots under trial that the larger portion of the cocksfoot on the markets of the world is a stemmy, free-seeding, and winter-dormant type. Wherever strain-improvement work has been carried on in cocksfoot, particularly in Great Britain, those improved strains approximate more and more closely to the New Zealand Akaroa type. The fine-leaved British indigenous selections from Aberystwyth, Wales, are the only exceptions.

(6) New Zealand Crested Dogstail.

Crested dogstail is grown to some considerable extent in New Zealand both for local consumption and for export. It is an important pasture grass in the Dominion, more particularly as a bottom grass on second-class country devoted essentially to sheep rather than dairying. Its most valuable attributes are its persistency, by reseeding or otherwise, on moderately low-fertility soils, its ability to establish from seed on surface-sown country, its high palatability, and its good winter and early spring growth. Seed is harvested in the main from short-rotation soil-types, and the crop is cut with the reaper and binder. Stripping is also carried out from old pasture areas. Strain work is in progress in the Dominion on crested dogstail, but no commercial lots of a superior type have yet been produced. New Zealand crested dogstail is of high quality in regard to germination, purity, and appearance.

(7) New Zealand Red Clover—Broad Red Type.

The only red clover type so far produced in New Zealand is the broad red, and there are in New Zealand no areas where specific persistent pasture types have been developed to resemble the Montgomery and Cornish Marl type. Red clover seed production in New Zealand is essentially the business of the short-rotation farm where at most pastures are left down three to four years. None the less, the type of broad red clover produced in New Zealand is decidedly more persistent than certain European types such as Lombardy red, Italian red, and is slightly superior—under New Zealand conditions at least—to the bulk of imported broad red clover from Great Britain. Various names—such as early-flowering red clover, cow-grass, and double-cut cow-grass—have been applied to this type.

The broad red type is the least persistent of all the red clovers. It grows rapidly from seed, and while it lasts easily outyields any other type of red clover. It is early in the spring and flowers earlier in the season than the late red types. Normally little or no seed is set in the early part of the season, due largely to the absence of humble-bees at this period. The spring growth is cut for hay, and a second crop of flowers is produced in early autumn, when seed is set in abundance, and it is at this time that the

seed crop is taken in practice. The average type of plant common in broad red clover is typically lax at the crown at all stages of growth, relatively few tillered, and producing stem rather than leafy growth, especially at mid-season. None the less, there will always be a place in temporary and short-rotation pastures for the broad red clover type, both for the production of grazing and for hay.

The quality of New Zealand Broad Red clover is excellent from a germinating, purity, and appearance point of view, and, while there is no intention at present to certify the crops, these can certainly be recommended for use in Great Britain and elsewhere before any of the low-persistent European broad red types.

(8) Montgomery Red Clover.—New-Zealand-grown Certified Montgomery Red.

Small importations of Montgomery Red clover are being made and trials conducted to confirm the type. Such importations after a satisfactory plot trial are regarded as mother seed, and the resultant crop certified to as New-Zealand-grown Montgomery Red type. Montgomery Red has a decided place in New Zealand, and could with great advantage replace all broad red seedings made in permanent pastures and in long-rotational pastures over three years' duration. Broad red clover is essentially the ideal temporary and short-rotation pasture species, unexcelled for quick feed along with rye-grass and for hay production. In permanent-pasture sowings broad red is inclined to smother during the first year down and then to gradually go out, leaving the pasture poorer than if it had never been sown. Montgomery Red is slower establishing, and it comes away later and extends well into the summer period, where, along with cocksfoot, it carries on after the seasonal decline from the rye-grass and white clover peak.

Great Britain needs the Montgomery Red type, and all the world over there appears to be a growing demand for a red clover type more persistent than broad red. Canada, Russia, Sweden, and Germany particularly are working on and evolving red clover types intermediate between broad red and Montgomery Red clover. Such names as Altaswede, Hersnap, and Late Red are applied to this type. In New Zealand this intermediate type from the countries named and also those from Great Britain are essentially winter-dormant—much more so than broad red and Montgomery Red. In persistency also they range between these two types. Britain seems to lean favourably towards these intermediate late red types, and where winter conditions are too severe for any winter growth from any red clover they may be satisfactory enough, but under the milder New Zealand winters the winter-dormant period is a disadvantage. Montgomery Red clover does not winter-burn in New Zealand to anything like the extent that the intermediate late red types do.

New Zealand has an excellent climate for red clover seed-growing, and if the demand arises could supply the Empire requirement for broad red and for the extra late red clovers of the Montgomery and Cornish Marl type. This does not necessarily mean that growers of the extra late red type in Montgomeryshire and Cornwall will be superseded by New Zealand as a producer of this

FIG. 9 NEW ZEALAND BROAD RED CLOVER IN FULL FLOWER.

Compare with Montgomery Red in Fig. 10, which up to time of photo had identically the same treatment.

FIG. 10. MONTGOMERY RED CLOVER GROWING IN NEW ZEALAND.

The type is essentially different from the broad red. It is dense crowned, multitillered, and late flowering (compare with Fig. 9). These characteristics hold in New Zealand just as they do in Britain.

class of seed. As before stated, no mother-seed areas of these types exist in New Zealand, and an excellent arrangement could be made through New Zealand and British merchants for Montgomery and Cornwall growers to produce and sell certified mother-seed to New Zealand for seed-production purposes. The same applies to growers of Kentish wild white clover. If the world seed-trade demands extra late red, every effort should be made within the Empire for seed of this type to be produced as rapidly as possible, and I can see great possibilities of the areas in Great Britain being earmarked and certified as mother-seed areas, the seed from these to be sent overseas to New Zealand or Australia for increase growing and return. The certification scheme already in operation in New Zealand makes this project immediately practicable and possible. A similar certification scheme should also be inaugurated in Great Britain to ensure that the mother seed supplied to New Zealand is true to type and up to mother-seed standard in all respects.

(9) LUCERNE.

Lucerne probably varies more from a strain point of view than any other pasture or fodder plant. So outstanding are strain differences that virtually every lucerne-growing country in the world considers its own strain the best. New Zealand lucerne seed for the most part is grown in Marlborough—the northern portion of the South Island. The Marlborough lucerne does better in New Zealand than any other strain, although Hunter River strain from Australia is scarcely distinguishable from it. All cold country lucernes, such as Grimm, are winter-dormant in New Zealand, and are on this account comparatively valueless. In lucerne the inbred characteristic of winter dormancy is most marked, and, as in the case of rye-grass, cocksfoot, and red clover, even when these forms are grown in a country of milder winters than the country of origin, they still retain this characteristic, so deeply ingrained has it become by years of moulding under definite and distinct habitats.

This, again, brings up the whole point as to what strain of lucerne is best for Great Britain and all other countries that have a moderately temperate climate. As in the case of rye-grass, cocksfoot, and red and white clover, it would appear sound that these countries should import their lucerne-seed requirement from countries as mild or somewhat more mild than their own. For Great Britain's requirement, therefore, New Zealand Marlborough lucerne or Australian Hunter River type should fill the need far better than cold-country lucerne types where the long winter-dormancy characteristics are so deeply inbred. Hot dry-land lucerne types, again, should be avoided, for the conditions under which these have been evolved are not inducive to high-producing leafy types, but to low-production, stemmy, free-seeding, quick-maturing, non-persistent types, and these characteristics must be so firmly ingrained into the plant that even though brought to very much more favourable conditions for growth and high production they are unable to respond to the latter conditions. New Zealand Marlborough lucerne has been tried experimentally in Britain, and, as one would surmise, the type showed up extremely well.

Good lucerne seed crops are produced in New Zealand, the climate and soil of Marlborough favouring high production, good even ripening, and excellent harvesting. The crops are virtually pure lucerne stands, and so dense is the growth that most weeds, including even Californian thistle, succumb to the frequent cuttings possible from the New Zealand strain and from the smother of the quick recovery and excellent growth. The seed-machinery plants in Marlborough have specialized in lucerne-seed dressing, and they turn out samples virtually 100 per cent. pure. The germination is always excellent.

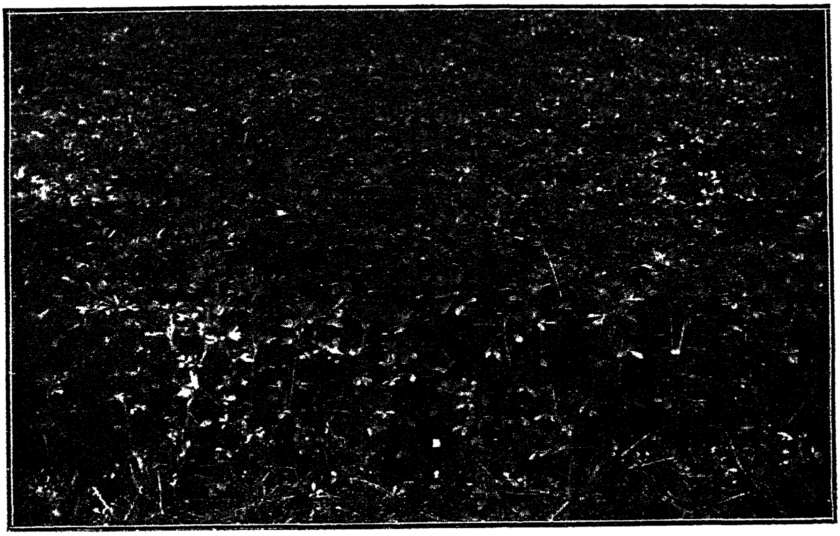


FIG. 11. NEW ZEALAND LUCERNE, SHOWING GOOD LEAF-DEVELOPMENT OF A TYPICAL CROP.

(10) LAWN SEEDS: CHEWINGS FESCUE, BROWN-TOP, AND CREEPING-BENT.

New Zealand ranks as an important lawn-seed producing country. Under our peculiar environment there have come to be produced a type of fine-leaved fescue—Chewings fescue, two types of brown-top (*Agrostis tenuis* vars.), and a form of New Zealand creeping-bent (*Agrostis stolonifera* var.).

These fine-leaved grasses and their varieties constitute the main bulk of fine lawn-seed the world over. Actually the three species and their varieties are dissimilar in habitat requirement. Chewings fescue is suitable for dry low-fertility hard habitat greens and fairways; brown-top is suitable for the stiff, heavier, moderately low-fertility moist class of soil-type; and creeping-bent flourishes best on wet greens and where liberal composting is possible. Brown-top is the grass *par excellence* for greens and lawns, and every effort should be made to attain to the brown-top requirement as regards habitat; in other words, the treatment of the greens and lawns

should be such, or made such, that brown-top may thrive there strong and healthy. Chewings fescue makes excellent greens where competition effects from other lawn plants are small, but the fine-leaved fescues on the whole will not stand such severe cutting as brown-top. Creeping-bent in natural associations is more or less a bog-land grass, and spreads by means of overground stolons or runners. When these runners are buried with compost, and if the lawn or green is kept wet, then a fine playing-green is the result. Under dry conditions and with little or no compost a poor rough green results.

All three species are harvested in New Zealand—Chewings fescue and brown-top far in excess of creeping-bent. There are actually but few areas in New Zealand wet enough to grow creeping-bent on a payable basis. Chewings fescue and brown-top and their varieties, however, will always occupy first place in the making of lawns, and in the production of seed of these species New Zealand may rightly claim that no better and purer seed is produced anywhere else in the world.

Stapledon, dealing with the question of species and strains and seed mixtures for lawns, and enunciating the general principle of "one lawn one growth-form," claims as conforming to this principle a sample mixture of two species—brown-top and Chewings fescue. Quoting Mr. Dawson's experiments in connection with green-keeping research at St. Ives, England, he says: "Most striking, for example, are the plots of New Zealand bent (brown-top) and New Zealand Chewings fescue . . . and it would seem not at all unlikely that in these two grasses we have ready to hand—for the seed of both is harvested on a commercial scale in New Zealand—two forms which to a marked degree conform to the tentative principle which I have enunciated, and which may be expected to blend in an admirable manner if sown together as the sole ingredients in a seeds mixture."

So far as growth-form is concerned Chewings fescue and brown-top are almost identical, both spreading by short underground tillers that later develop multitillered crowns which, blended together, make the ideal turf.

Strain work on brown-top in New Zealand has led to the identification of two distinct types, ecologically and botanically. One type occupies the normal, rather wettish, stiff, sour clays of both Islands, and is the dark-green broader, flat-leaved form with short underground tillering rootstock. The other occupies what may be termed run-out arable light wheat country, in the drier districts of Canterbury particularly. This form is somewhat finer in the leaf, with leaf often distinctly rolled rather than flat and of a grey-green colour. The rootstock has strong underground creeping stems, by means of which it is able to tide over the dry summer period. The seed-head is more compact and coarser and the ligule is longer than in typical brown-top. Ecologically this dry-land brown-top fits in more essentially with a habitat suitable to Chewings fescue, and the form at once appeals as of great promise in association with Chewings fescue for greens that are too dry for the normal brown-top. It has probably not quite so good a colour as the true

brown-top, being greyish green rather than the normal grass-green. On the other hand, it is a better winter grower and has a much stronger rootstock, and apparently can keep alive and thrive moderately well on drier and more impoverished soils than can the true brown-top. In New Zealand the dry-land brown-top has been studied under lawn conditions for three years, and swards as well as ordinary brown-top and Chewings fescue. Its better winter growth may enhance its value for conditions in Great Britain and America over and above the ordinary brown-top for certain soil-types.

Seed of Chewings fescue, dry-land brown-top, and the ordinary brown-top can be produced cheaply in New Zealand in virtue of

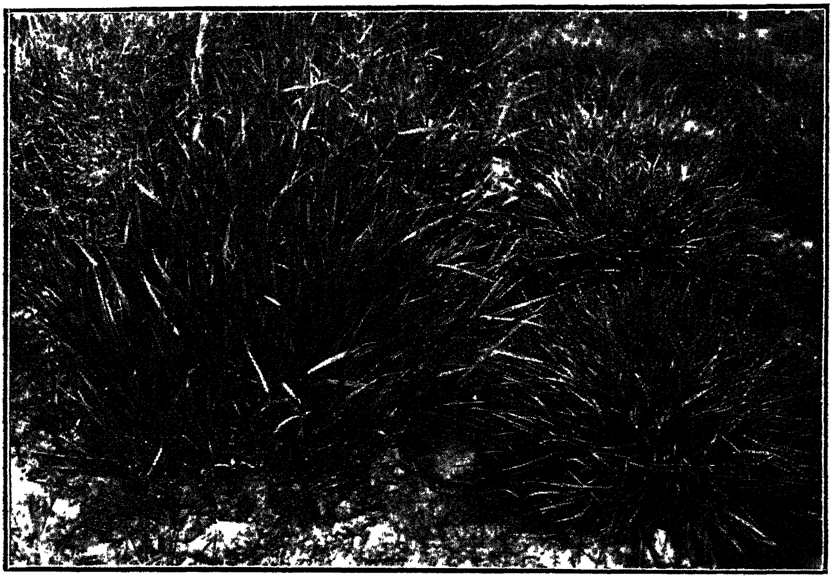


FIG. 12. SINGLE PLANTS OF NEW ZEALAND CERTIFIED BROWN-TOP (RIGHT) COMPARED WITH AMERICAN RED-TOP (LEFT).

The dense multitillered crowns of the brown-top enhance the value of this grass for lawns, whereas the coarse open-natured crown of the red-top renders this species useless for fine lawns.

the fact that pure swards of each can be readily secured over large tracts of country—the fescue by seeding down on very poor soil that agriculturally is very low priced, while the brown-top forms are successional volunteers on short-rotation soil-types, replacing the sown species after three or four years. Both forms of brown-top may be regarded as catch-crops. Cheap and efficient methods of harvesting—in the case of Chewings fescue the reaper and binder, and with brown-top the stripper—are almost invariably employed.

The pure swards and the efficient seed-cleaning plants produce samples in all cases virtually 100 per cent. pure. Purity in lawn seeds is of vital importance, and there are extremely few trouble-some lawn weed seeds met with in New Zealand Chewings fescue and brown-top.

Most of the ordinary brown-top now exported is certified true to type and free of red-top. Red-top is probably the worst lawn-grass in the world. Its coarse erect growth and its inability to form a turf under mowing render it quite useless and even harmful in lawns. Under New Zealand conditions at least, there is little likelihood of red-top being present in the ordinary brown-top crops, as red-top readily smothers out under the intense competition set up by a good brown-top sward. On wet somewhat peaty areas, however, red-top may persist, and the certification scheme here is necessary to eliminate these areas from being harvested for seed.

Chewings fescue seed, in common with that of most fescues, is short-lived, and care should be exercised in buying to get current season's crop. Every effort is made at the New Zealand end to get the seed dressed, cleaned, and shipped with the minimum of delay, and overseas importers would be well advised to estimate their requirement well in advance and to place orders in New Zealand as soon as they possibly can after the harvest, which takes place about January.

(11) OTHER SEEDS.

Lotus major, Lotus hispidus, suckling clover, clustered clover, timothy, alsike, Poa trivialis, prairie-grass, Italian rye-grass, Phalaris tuberosa (syn. bulbosa), and Danthonia pilosa (indigenous) are also harvested to some extent in different parts of New Zealand, and can be grown here to perfection if the demand justifies taking up these lines for export. There is also a good opportunity for Britain to use New Zealand more extensively for the raising of vegetable seeds, root seeds, fodder-crop seeds, and flower seeds.

Conclusion.

New Zealand, as has been shown, has some really valuable strains of pasture seeds to offer other grassland countries. It has the climate to produce seed, and machinery to harvest and clean it, unsurpassed by any other country in the world. Its Government scheme of certification, whereby a guarantee of type is given, enables seed-merchants to handle and farmers to buy with the utmost confidence.

Special habitats may require types other than those offering from New Zealand at the moment. New Zealand is prepared to enter into arrangements with any country that has not the climate to produce its own seed to once-grow for return seed of any strains of peculiar value to the country concerned.

Orchard Cultivation.—The Orchard Instructor, Nelson, reports that during the past two years no ploughing has been done in the research orchard at Appleby, tractor cultivation having been substituted. In 1930 an ordinary double-gang disk-harrow was used, followed by a spring-tooth cultivator. In 1931 heavy double-gang cover-crop disks were used entirely, with very satisfactory results. The land is in splendid tilth to a good depth. The Instructor adds that it may be necessary to plough in occasional years as the land may have a tendency to work away slightly from the trees.

THE MANAWATU-WEST COAST DAIRY-FARM COMPETITION.

RESULTS FOR INITIAL YEAR 1930-31 REVIEWED.

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THE general scope, conditions, and operation of the Manawatu-West Coast Dairy-farm Competition were described in this *Journal* for September, 1930, to which interested readers are referred. The conditions of the competition were designed from the outset to ensure that the awards would be determined largely by the financial returns, but that the provision for the sound future conduct and development of the farms would also be taken into account.

Over £70 was readily donated by business and farming interests for the purpose of providing attractive prizes and meeting incidental expenses, while progressive farmers of a type suitable as competitors entered freely in numbers sufficient to bring about the success of the competition as an instructive enterprise. Twenty-seven entries were received. Six of these were rejected in the preliminary stage because the management of the farms they represented did not conform with the rules of the competition, and unexpected developments led to three competitors dropping out during the course of the competition. Hence the work on eighteen farms were considered in finally making the awards.

The winning competitors were :—

1st : A. J. Baxter, Aorangi, Feilding	£25 cash and Cup.
2nd : H. L. Knudsen, Tiritea, Palmerston North	£15 cash.
3rd : H. V. Benge, Feilding ..	£5 cash.

SUMMARIZED DATA ON COMPETING FARMS.

The following facts indicate the scope, nature, and returns of the competing farms :—

Average size of farm	86·5 acres
Largest farm	201 acres.
Smallest farm	30 acres.
Average size of herd	51 cows.
Largest herd	85 cows.
Smallest herd	26 cows.
Average production of herds	264 lb. butterfat per cow.
Highest production of herd	333 lb. butterfat per cow.
Lowest production of herd	184 lb. butterfat per cow.
Average production of butterfat per acre	164 lb. butterfat.
Highest production of butterfat per acre	285 lb. butterfat.
Lowest production of butterfat per acre	70 lb. butterfat.
Average valuation	£56 per acre.
Highest valuation	£85 per acre.
Lowest valuation	£20 per acre.
Average cost of producing 1 lb. of butterfat ..	11·3d.
Lowest cost of producing 1 lb. butterfat	9·3d.
Highest cost of producing 1 lb. butterfat	15·6d.
Average cost of land (at 6 per cent. interest) to produce 1 lb. of butterfat	5d.
Lowest cost of land to produce 1 lb. of butterfat ..	3·6d.
Highest cost of land to produce 1 lb. butterfat ..	6·3d.

Two farms carried a substantial number of sheep, which so reacted on returns as to make it advisable to exclude these farms in a study of the dairying results. Therefore the figures in the foregoing table relative to the average production of butterfat per acre and the average cost of butterfat cover sixteen farms only.

Comment on General Results.

The general figures possess several interesting features. The herd average of 264 lb. butterfat to many may not seem as good as might reasonably be expected in a competition of this nature. However, it cannot be compared with herd averages as commonly referred to in connection with herd-testing association results. The competition herd-average was computed as far as possible on the basis of the number of cows in the herd irrespective of whether these were milked or not, considered in conjunction with the butterfat actually sold. The Dominion average for the season 1930–31 was 201 lb. per cow, covering all dairy cows in milk or dry. The latter figure covers not only factory returns, but family consumption of milk and cream, together with new milk fed to calves and wastage in separation. Hence the competition average is more superior to the best recorded Dominion average than the figures given suggest. The average of 164 lb. per acre compares very favourably with the Dominion average of somewhat less than 80 lb., according to the Farm Economist's figures, brought up to date last year.

While the average butterfat production in the district covered by the competition has not been ascertained accurately, it is safe to say that it is at least 40 lb. per acre less than the per-acre average of 164 lb. achieved by the farms in the competition. This gives particular significance to the fact that the cost of land, on a 6-per-cent. interest basis, in the competing farms amounted to 5d. per pound of butterfat. This means that if the well-known share-milking basis of one-third for land, one-third for labour, and one-third for all other expenses were correct, then in the case of the farms participating in the competition the cost of land was too high. On the figures already given this land was used to better effect that is usually the case, so that on the average the cost of land is still more excessive than it was in the competition. The remedy seems to be either lower land-values or lower interest and rent charges, or both.

Methods of obtaining required Data.

The items of information used in making the awards fall broadly into four groups: (1) Farm receipts and payments; (2) values of land, stock, and equipment, &c.; (3) allowances for wages, interest, depreciation, &c., in regard to which often no payments were made by the competitors; (4) farm practice, inclusive of both methods and results.

Farm Receipts and Payments.

The competitors were required to submit at the close of the competition a statement of transactions which they could support by documents, and this statement, plus allowances, referred to later, provided the information necessary to arrive at each farmer's

financial results. In order that the competitors might be in a position to supply the required statement without leading to undue difficulty in its preparation or checking, competitors were asked at the outset to make all farm payments by cheque and to bank all farm moneys received. Most of them were already doing this.

Incidentally, the domestic expenditure of the competitors was not considered, and information regarding interest payments, rents, and mortgages of any kind was not required. Allowances based where appropriate on valuations, as will be explained, served to cover such matters. In addition, the competitors were required to keep all dockets and documents relating to sales and purchases—for example, sales of pigs, calves, &c. To assist the competitors further a fairly exhaustive list of possible items of expenditure and income which should be noted was supplied to them.

It is recognized that this system of securing a statement of payments and receipts is not perfectly free from danger of misrepresentation. For instance, a competitor could sell some one else's butterfat or pigs in his own name. But it would be difficult to eliminate completely the possibility of this type of fraud in any system of recording accounts. It seems that in any system the competitor's honesty must be trusted to some extent. Incidentally, the judges' knowledge of the individual farms, gained from the several visits and their knowledge of farming generally, does not make misrepresentation easy.

VALUATIONS.

Government valuations and owners' payments or valuations in respect to land, equipment, &c., were all considered unsatisfactory for the purposes of the competition, for which it was decided to have valuations made specifically. The work of valuation was undertaken gratuitously by two well-known local farm valuers, Messrs. David Collis and Oscar Monrad.

They adopted a standard of land prices which ranged slightly lower than would be asked by the owners from prospective purchasers and higher than would be accepted for loan purposes, thereby closely approximating the true commercial values at that time.

Herd values were based on a standard value of £12 per head for a sound mature cow of good average dairy type, ranging downwards from this figure according to age and quality. When pedigree animals came under consideration special pedigree values were not recognized.

All pigs and dry young developing cattle were valued at the beginning and again at the end of the period covered by the competition. This enabled the competitors to be given appropriate financial recognition for the amount of care, feed, &c., given such stock, and resulted in the appearance among items of farm income of entries reading "increase in value of young female stock" or "decrease in value of pigs on hand," &c.

Reserves of feed, such as hay, silage, and roots, were similarly valued at the beginning and the end of the period covered by the competition, the standard values used being hay £3, silage £1, and

roots 10s. per ton. As the result of such valuation, if a competitor finished the year with 5 tons less hay and 7 tons less silage than he had at the beginning, then, among the items of expenditure appearing in his statement would be "Decrease in value of fodder on hand, £17." Thus proper adjustment was made in those cases where entrants during the competition period operated on the results of previous effort.

ALLOWANCES.

The following allowances were made in determining the cost of production :—

(1) Interest at the rate of 6 per cent. on the value of land, stock, and equipment.

(2) Depreciation at the rate of 16⅔ per cent. on all mature cattle—that is, on the basis of six years' producing-life.

(3) Depreciation at standard rates on equipment, estimated at 10 per cent. on farm implements and 5 per cent. on milking-plant.

(4) Labour, even if not paid for, as in the case of sons working for their parents, at a minimum of £2 a week including keep, and actual rates if higher than minimum. Labour of the farmer-owner was charged at £2 10s. a week. This allowance is intended to cover merely the farmer's wages for his manual labour. It was assumed he would be to some extent more industrious and skilful than hired labour, hence the allowance of an extra 10s. a week. It remained for the reward for his mental labour to come from (*a*) his profits, and (*b*) interest (already provided for) on his equity in the property. In short, the farmer-owner was considered in a dual role—(*a*) as a labourer for whom wages must be allowed, (*b*) as an owner relying for reward upon interest and profits.

FARM PRACTICE—METHODS AND RESULTS.

Data in regard to farm practice and results were obtained by the judging committee in the course of its three visits. It was possible to check the principal item—that of butterfat production —by reference to factory returns.

INDIVIDUAL FINANCIAL RESULTS.

From the beginning competitors were assured that information supplied by them would be treated as confidential. There has been a number of requests for detailed information about the individual farms, but it is obvious from the confidential nature of such information that it cannot be supplied. Even if there were no obligation to treat as confidential the information received from competitors, it is questionable whether it would be of much service to the general public to publish much of the information desired, especially that relative to finance; usually bald statements of accounts without a knowledge of the specific circumstances attaching to such statements are not altogether satisfactory.

The accompanying condensed statements of the year's financial results on three typical competing farms illustrate how different types of management were reflected in the ultimate returns :—

Farm A.—42 acres at £85 per acre, 36 cows; 11,997 lb. butterfat; average fat per acre, 285 lb.; average fat per cow, 333 lb.

	£	s.	d.
Expenditure—			
Interest on property	251	14	11
Depreciation on stock	70	3	4
Interest and depreciation on implements	12	0	0
Outgoing and depreciation on milking-plant	14	8	0
Insurance	1	9	2
Rates	20	4	3
Horse charges	4	14	0
Seed and manure	2	6	8
Hired labour	117	8	0
Owner's labour	130	0	0
Decrease in value of fodder on hand	7	0	0
Pig purchases	8	2	0
	639	10	4
Miscellaneous income—			
Calves	7	19	6
Skins	0	7	0
Pigs	56	0	1
Increase in value of pigs on hand	6	5	0
Increase in value of young female stock	23	0	0
	93	11	7
Summary—			
Expenditure	639	10	4
Less Miscellaneous income	93	11	7
Cost of 11,997 lb. butterfat	545	18	9
Cost of 1 lb. butterfat	11d.		

Farm B.—113 acres at £42 10s. per acre; 51 cows; 15,417 lb. butterfat; average fat per acre, 136 lb; average fat per cow, 302 lb

	£	s.	d.
Expenditure—			
Interest on land and stock	338	15	10
Depreciation on dairy stock	103	13	4
Interest and depreciation on implements	25	0	0
Outgoing and depreciation on milking-plant	20	8	0
Power	27	0	9
Insurance	3	8	10
Workers' insurance	1	6	0
Rates	18	4	9
Manure	40	11	11
Seed	11	4	0
Labour	111	0	0
Owner's labour	130	0	0
Pig purchases	12	12	0
Decrease in value of pigs on hand	49	5	0
	892	10	5
Miscellaneous income—			
Pigs	126	6	4
Poultry and eggs	5	0	0
Increase in value of fodder on hand	28	0	0
Increase in value of young female stock	95	0	0
Sheep returns	11	12	0
	265	18	4
Summary—			
Expenditure	892	10	5
Less Miscellaneous income	265	18	4
Cost of 15,417 lb. butterfat	626	12	1
Cost of 1 lb. butterfat	9·7d.		

Farm C.—79⅝ acres at £45 per acre; 30 cows; 8,738 lb. butterfat; average fat per acre, 110 lb.; average fat per cow, 291 lb.

	£	s.	d.
Expenditure—			
Interest on property	245	2	5
Depreciation on stock	58	3	4
Interest and depreciation on implements	13	10	0
Outgoing and depreciation on plant	12	0	0
Rates, taxes, &c.	24	10	1
Power	16	17	4
Manure	38	18	0
Seed and hire of team for special cropping	11	3	9
Veterinary medicine and attention	19	18	7
Stock-feed	14	18	4
Pig purchases	28	1	6
Hired labour	6	18	0
Owner's labour	130	0	0
Decrease in value of pigs on hand	3	12	0
	623	13	4
Miscellaneous income—			
Calves	2	18	0
Pigs	51	18	5
Poultry	39	18	2
Increased value of fodder	10	10	0
Increased value of young female stock	65	10	0
	170	14	7
Summary—			
Expenditure	623	13	4
Less Miscellaneous income	170	14	7
Cost of 8,938 lb. butterfat	452	18	9
Cost of 1 lb. butterfat	12·4d.		

DIFFERENCES IN TYPICAL FARMS.

In the competition Farm A excelled the others in per-acre production and herd average of butterfat. In view of the per-acre production it is naturally a highly fertile farm, since there was no outlay on fertilizers.

In comparison Farm B consists of land of much lower quality. On Farm A £85 worth of land yields 285 lb. butterfat, while on Farm B £85 worth of land yields 272 lb. butterfat, and when the fertilizers used on Farm B are taken into account the cost of land in the butterfat production of Farm B is substantially greater than in Farm A. Nevertheless, Farm B produces butterfat at a price substantially lower than Farm A mainly because—

(1) One labour unit produces 7,400 lb. of butterfat on Farm B, against 6,000 lb. on Farm A.

(2) The increased value of the young female stock on Farm B approximates the depreciation allowed on the mature animals, whereas in Farm A it falls far short of doing so. In Farm B herd wastage is eliminated by the growing of young females, while on Farm A it is not.

(3) On Farm A during the year of the competition feed reserves were depleted to the extent of £7 value, while on Farm B they were built up to the extent of £28.

The most substantial differences between Farm B and Farm C lie in the following facts :—

(1) The land is at approximately the same value in each farm; Farm B secures 136 lb of butterfat per acre, against 110 lb. per acre in Farm C.

(2) Pigs to utilize by-products are reared on Farm B and purchased on Farm C.

(3) Several charges, such as manure, stock-feed, and veterinary attention, bear relatively heavily on Farm C.

These comparisons illustrate how various practices affected the financial returns of the competing farms.

PRACTICES ASSOCIATED WITH SUCCESSFUL RESULTS.

In the competition major matters of management which came into prominence because of the consistency with which they were associated with attractive financial returns were (1) feeding of dairy stock in a more efficient manner than is normally carried out; (2) rearing of good young females in sufficient numbers to repair herd wastage and provide for expected expansion; (3) more than usually thorough utilization of dairy by-products by the exploitation of such sidelines as pig-rearing.

BETTER FEEDING THE OUTSTANDING FEATURE.

The competition strikingly directs attention to the potentialities for increased profitable production to be found in the better feeding of our present stock. The most successful farms in the competition were those which gave most thorough attention to the good feeding of their stock all the year round along lines which are generally accepted as efficient. Particular attention was paid to the provision of ample supplies of suitable feed for use in the winter and early spring period, when the nutriment directly available from pastures is likely to be inadequate. On the whole, and particularly by the prizewinning competitors, the provision made for late summer feeding of dairy cows was better than is generally made.

The results obtained by the winner of the first prize exemplify particularly well how good winter feeding was reflected during the early part of the season in the butterfat returns. The daily production in August was approximately twice as good on the winning farm as it was on the farms of the district generally. In the district generally for every 100 lb. of butterfat produced in December only 35 lb. was produced in August, while on the first-prize farm over 68 lb. of butterfat was produced in August for every 100 lb. produced in December.

The good early start in production on the winning farm is reflected substantially in returns during the remainder of the spring and early summer, with the result that the average daily production during September, October, and November is very nearly as high as that for December, which is generally the flush period of butterfat production. To realize the full significance of this, it is necessary to bear in mind that practically all farmers—bad as well as good—secure high production in the season of plenty of feed, and hence the test of the

efficiency of a dairy-farmer's system of feeding becomes a comparison of the production during the low-growth periods and that of the rapid-growth periods. It is when this test is applied that the performance of the winning farm during spring and early summer is seen to be outstanding. *Prior to December the winning farm produced 377 lb. of butterfat for every 100 lb. produced in December, whereas the farms of the district generally produced only 296 lb. prior to December for every 100 lb. produced in December.*

From this it may be deduced that had farmers of the district generally produced as well relatively in the early part of the season as did the winner their production up to the end of December would have been 28 per cent. greater. The figures for the district generally are based on the factory returns of approximately 45,000 cows.

Relatively early calving was partly responsible for the comparatively good production secured in the early part of the season on the winning farm, but early calving generally proves futile unless the stock have the comparatively good condition and the strength which can be secured only by adequate suitable feeding during winter and early spring.

The main features of the feed provision on the farms which obtained good results were—

(1) Seasons of feed scarcity were avoided.

(2) At the different seasons the feed provided was suited in quality or character to the needs of the stock—for example, well balanced, highly digestible feed was provided in the latter part of the summer, whereas on many farms at this period plenty of feed, but of unsuitable type, is provided.

(3) Wastage of feed during periods of rapid growth of pastures was largely avoided.

The feeding system practised by the successful competitors led not to phenomenally good average yields of dairy stock, but to the carrying of more than the average number of stock, the butterfat production of which, while not outstanding, was well above the average of the district generally. From this it is not correct to infer that herds of exceptionally high production are not desirable. It is correct only to infer that such herds are not always handled in an economical way—the weakness is in respect not to such herds themselves, but to their occasional management.

Measures giving Good Feed Provision.

The comparatively good feed provision throughout the year was secured principally by the following means :—

Controlled Grazing.—On some of the competing farms there was considerable room for improvement in grazing management. On the other hand, there were several competitors whose grazing methods did not leave much scope for adverse criticism. These practised a relatively simple system of controlled grazing which results in leafy actively growing pastures at periods when many pastures are stemmy or dormant. This system differs in points of vital practical importance from what has been called a new system of intensive rotational

grazing brought, in recent years, to the notice of New Zealand farmers by information emanating from Britain and Germany.

The New Zealand system which has proved successful on farms in this competition and on other farms in the district calls for alternate periods of "spelling" and of relatively heavy stocking of pastures. In these matters it is similar to the European system, from which, however, it differs in the following important respects: (1) It does not call for the periodical specially close grazing which seems to be insisted on by advocates of the European system, and which apparently results necessarily in undesirable punishing of both pastures and stock; (2) it does not necessitate the used of a considerable number of "followers" consisting of store stock, which ordinarily are available only in comparatively small numbers on typical dairy-farms; (3) it does not demand a comparatively large number of unusually small paddocks; the farm awarded first prize consisted of fifteen paddocks totalling 90½ acres, and some other competing farms the returns of which were prominent were somewhat less subdivided.

Top-dressing.—The amount of top-dressing carried out by the competitors generally was somewhat scant in comparison with the practice in some other dairying districts, and probably increased top-dressing by many of the competitors would have yielded substantial profits. The amount of top-dressing material applied by the prizewinners was appreciably higher than that applied in the district generally, and averaged in cost the sum of 17s. for each cow milked.

Ensilage.—Ensilage was the main measure adopted by the successful competitors for the purpose of utilizing effectively any excess feed available in the season of rapid growth of grassland. On the prizewinning farms the employment of ensilage did not lead to the complete elimination of hay, which was made when suitable weather prevailed. Ensilage was of particular value in handling the early-season growth of the lucerne areas—growth which became available in uncertain haymaking weather and when green feed was not required to supplement the feed obtainable from the pastures. In addition to the three prizewinners, all but three of the remaining competitors practised ensilage, and two of these three expressed their intention of adopting it in the future.

Lucerne Culture.—Lucerne came into prominence in the competition because it occupied an important place in the feed provision on the farms of the three prizewinners. It was used variously as green feed for the dry late-summer period, as a source of hay when weather favoured haymaking, and of silage at other periods. By turning the growth of the early part of the season into silage virtually another "cut" is obtained each season, for otherwise the first cut is often removed relatively late in an endeavour to obtain weather suitable for haymaking.

The lucerne culture practised by the prizewinners was simple and relatively inexpensive. Phosphatic top-dressing was carried out fairly liberally; the first cut of the season was removed at an early stage for ensilage, and so the shading effect of any weeds which outgrew the lucerne during the cold season was minimized; the

amount of cultivation carried out was not considerable, and grazing of the lucerne was avoided as much as possible.

Special Arable Crops.—The advisability of totally discarding the use of the plough in dairying, and of depending for feed upon pastures alone, is at time seriously discussed in the district covered by the competition. In view of this, it is specially interesting that arable crops were prominent in the competition. Firstly, they played an important role on the farms awarded the prizes, and, secondly, they were grown by sixteen out of eighteen competitors. The mangel was the most popular for winter use, and the soft turnip, used either alone or as a companion to green lucerne, was favoured for use in the dry summer period. The soft turnip serves well in place of lucerne should there be an interval during the dry period in which suitable green lucerne is not available, and if for any reason the lucerne becomes too stemmy and indigestible to give the best results in butterfat production the use of soft turnips in conjunction is found to give more suitable feed. In winter the root and other arable crops were fed with good results not only to cattle, but also to pigs. Soft turnips alone were very useful for the summer period on farms without lucerne areas.

From the facts already given it is clear that the most successful competitors took special care to have an assured and adequate supply of reserve feed comprised of hay, silage, and special forage crops for use both in summer and winter. In view of the varied sources of supply only an extremely abnormal season would have caused a feed shortage during the customary critical periods when feed reserves are required.

REPAIRING HERD WASTAGE.

The competitors generally, and especially those who were awarded prizes, took effective steps to repair normal herd wastage and in many instances to allow also of future herd expansion. The three prizewinning farms considered together raised young females (yearlings and springers) at the rate of sixty for every hundred cows milked. For purpose of comparison, interest attaches to the fact that in a recent farm survey embracing Taranaki and Auckland dairying it was found that forty-three young females were being carried for every one hundred cows milked.

Taking into account all competitors the provision for herd maintenance is summarized in the following data: Twelve of the competitors, after providing for the replacement of a sixth of the herd each year, were in credit a total of £590, approximately £50 each, from young females raised; the highest credit was £107 and the lowest £11. Four, after making a similar allowance for herd replacement, were a total of £100 in debit respecting young stock, an average of £25 each, the highest being £40 and the lowest £12. One came out even. One, by miscellaneous buying and selling, clouded the issue, and was not considered.

In arriving at the above amounts the surplus young females available for sale, after making provision for herd replacement at the rate of one-sixth of the herd annually, were valued at £6 10s.

per head for springing heifers and £3 10s. a head for yearlings—in both cases for animals of good type and condition.

From these facts it may be concluded that progressive farmers generally on typical Manawatu dairying land look upon the raising of dairy heifers to meet their own requirements as economical. Though regular herd-testing each year under the association or group system was not favoured by the majority of competitors, the breeding of female stock generally was based on butterfat production data relative to both sire and dam.

UTILIZATION OF BY-PRODUCTS IN SIDELINES.

The competition provided interesting evidence regarding the potentialities of sidelines. The prizewinners utilized skim-milk, together with lucerne and special annual crops, in such a way that their sidelines, apart from the provision for normal herd-wastage, were equivalent to approximately one slaughtered pig to every cow milked. The average for the Dominion is approximately one slaughtered pig to every three cows milked.

The main features of the pig-keeping practice of the successful competitors were (1) no purchasing of store pigs; (2) relatively wide grazing range; (3) no elaborate housing, although comfortable accommodation was available in severe weather; (4) use of very little purchased feed, winter feed being provided by crops grown on the farm.

On five of the competing farms poultry contributed fairly substantially to the returns. The data available from the competition were not sufficient to enable any definite conclusions to be formed, but they suggest the suitability of poultry, especially when efficient female or other light labour is available.

IMPORTANCE OF FARM MANAGEMENT.

The results of the competition emphasize strikingly the importance of management. The range in cost of butterfat production from approximately 9½d. to 15½d. per pound on farms in respect to which there has been uniformity regarding valuation and estimation of financial returns, can be attributed almost wholly to differences in management. In short, it exemplifies well that modern dairy-farming calls not only for skill in carrying out various operations, but also for intelligence in deciding what operations are to be carried out.

GENERAL CONCLUSION.

The methods used and the results obtained in the competition are not considered as necessarily suitable bases upon which to found generalizations relative to sound dairying. In many matters even the most successful competitors were not satisfied that the methods they employed during the year of the competition were productive of the best possible returns. It is felt, however, that the competition served a very useful purpose in directing attention to farm practices which give substantially better results than those generally obtained under similar conditions.

MANURING OF EARLY POTATOES.

EXPERIMENTS AT PUKEKOHE IN 1931.

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EXPERIMENTS in the manuring of early potatoes at Pukekohe, Franklin County, were commenced in 1926. During the first three years it was established that bonedust, the then most popular fertilizer, could be replaced more profitably with superphosphate plus a quantity of sulphate of ammonia sufficient to balance the amount of nitrogen contained in the bonedust. In the following year, 1929, experiments were conducted to ascertain the value of sulphate of ammonia, sulphate of potash, and Diammonphos, and to find the best method of application of superphosphate. In 1930 these experiments were continued with slight modifications; also an attempt was made to find out the most suitable quantity of superphosphate to use and to test the value of nitrogen in different forms. (See *Journal* for April, 1930 and 1931.)

The conclusions arrived at by the end of 1930 were as follows:—

(1) Superphosphate is the most efficient phosphatic fertilizer.

(2) Nitrogen contained in Ammophos, Diammonphos, and sulphate of ammonia gave large increases in yields.

(3) Potash had proved of little value in increasing the yield.

(4) The fertilizer should be applied as close to the sets as possible.

(5) Growers were advised to use as the result of these experiments whichever of the following was the cheaper: (*a*) Superphosphate 12 cwt., plus sulphate of ammonia 4–6 cwt., per acre; (*b*) Diammonphos* 4–6 cwt. per acre; (*c*) Ammophos† 20/20 and Ammophos 13/48, 6–9 cwt., per acre, using half of each.

THE 1931 EXPERIMENTS.

Further investigations in manuring the early potato crop were carried out by four experiments on four farms on Pukekohe Hill in 1931. The season was not very favourable for the very early crops, the weather proving fairly cold and boisterous.

Except for the experiment conducted on W. Buttery's farm, each treatment consisted of twenty-eight to thirty replicated plots, each of which was a single row 1 chain in length. Rows next to ploughing feerings and finishes, and fences, were not included in any of the experiments. The Northern Star (Gamekeeper) variety was used in all four trials.

* Diammonphos contains about 20·5 per cent. of nitrogen and 52·5 per cent. of phosphate expressed as P_2O_5.

† Ammophos is sold in two grades—20/20, which indicates 20 per cent. of ammonia (= 16·5 per cent. nitrogen) and 20 per cent. P_2O_5; and 13/48, which indicates 13 per cent. ammonia (= 10·7 per cent. nitrogen) and 48 per cent. P_2O_5.

Trial on G. T. Nicholson's Farm.

This experiment was conducted on a field cropped the previous season with two crops of potatoes, after being in pasture for five years. The treatments were :—

(1) Superphosphate 15 cwt. (44/46 per cent. tricalcic phosphate*).
(2) Superphosphate 15 cwt., sulphate of potash 2 cwt.
(3) Superphosphate 15 cwt., sulphate of potash 2 cwt., sulphate of ammonia 4 cwt.
(4) Superphosphate 15 cwt., sulphate of ammonia 4 cwt.
(5) Superphosphate 15 cwt., sulphate ot potash 4 cwt., sulphate of ammonia 4 cwt.

The plots were planted on 11th and 12th May, 1931, and were dug and weighed on 20th October. The trial was the same as conducted the previous year (1930), and almost similar to the trial carried out in 1929. Table 1 shows the results of the experiment in 1931.

Table 1.—Results in G. T. Nicholson's Trial.

Treatment per Acre.	Yield per Acre.			Increase of First-grade Potatoes over Treatment 1.	Net Value of Increase per Acre over Treatment 1.
	First Grade.	Second Grade.	Total.		
	Cwt.	Cwt.	Cwt.	Cwt.	£ s. d.
(1) Super 15 cwt.	104	15	119	..	..
(2) Super 15 cwt., sulphate of potash 2 cwt.	101½	15	116½	2½*	2 4 0†
(3) Super 15 cwt., sulphate of potash 2 cwt., sulphate of ammonia 4 cwt.	130½	15½	146	26½	3 18 0
(4) Super 15 cwt., sulphate of ammonia 4 cwt.	138	16½	154½	34	7 18 0
(5) Super 15 cwt., sulphate of potash 4 cwt., sulphate of ammonia 4 cwt.	135½	16	151½	31½	3 12 0

* Decrease. † Loss.

The rows treated with sulphate of ammonia were observed to grow more vigorously than the rows receiving none of this fertilizer. The last column in the table gives the per-acre value for the increased yield over Treatment 1, the value of the extra manure, extra bags, and cost of digging and carting being deducted from the gross value of the additional table potatoes. Also, since sulphate of ammonia is almost certain to increase the acidity of the soil, for every hundredweight of sulphate of ammonia used in each treatment 2s. has been subtracted as the estimated cost of liming to counteract the acidity. The first-grade potatoes sold for £8 per ton, a very low price for the time of the year.

In statistical treatment of the results presented in Table 1, the increase of Treatment 1 (super alone) over Treatment 2 (super and potash 2 cwt.) is not significant; the increase of Treatment 3 (super and potash 2 cwt. and sulphate of ammonia 4 cwt.) over Treatment 2 (super and potash 2 cwt.) is significant in first-grade and total yield; the increase of Treatment 4 (super and sulphate of ammonia 4 cwt.) over Treatment 1 (super alone) is significant in first-grade and total

* = 20·2 to 21·1 per cent. P_2O_5.

yield; Treatment 4 (super and sulphate of ammonia 4 cwt.) is significantly better than Treatment 3 (super and potash 2 cwt. and sulphate of ammonia 4 cwt.) in total yield, but is not significantly different from Treatment 5 (super and potash 4 cwt. and sulphate of ammonia 4 cwt.).

The use of potash has decreased the yield in each of the three comparisons, but only significantly so in one case in total yield. The use of sulphate of ammonia 4 cwt. has given the large increase of 1·7 tons per acre of table potatoes, or a net profit due to this fertilizer of £7 18s. per acre.

A survey of this experiment, which has been carried out now for three years, is shown in Table 2. The average yield for three years shows an increase of about 1 ton per acre of table potatoes, due to the use of 4 cwt. of sulphate of ammonia.

Table 2.—G. T. Nicholson's Trial over Three Years.

Treatment per Acre.	Average Yield per Acre of First-grade Potatoes.			
	1929.	1930.	1931.	Average.
	Tons.	Tons.	Tons.	Tons.
(1) Super 15 cwt.	4·6	6·4	5·2	5·4
(2) Super 15 cwt., potash 2 cwt.	4·38	6·7	5·1	5·39
(3) Super 15 cwt., potash 2 cwt., sulphate of ammonia 4 cwt.	5·32	7·6	6·5	6·47
(4) Super 15 cwt., sulphate of ammonia 4 cwt.	5·32	7·5	6·9	6·57

Treatment 5 was not included in the 1929 trials, and therefore is not shown in the above table.

Trial on P. A. Miller's Farm.

This trial was laid down on a field which was ploughed from a four-year lea in the autumn of 1930, on which two crops of potatoes were taken in the 1930–31 season. The experimental area was planted on 27th May, 1931, after a catch-crop of mustard for green manure. The treatments were as follows:—

(1) Superphosphate 15 cwt., sulphate of ammonia 4 cwt.
(2) Superphosphate 15 cwt., sulphate of ammonia 4 cwt., sulphate of potash 2 cwt.
(3) Superphosphate 15 cwt., sulphate of ammonia 4 cwt., sulphate of potash 2 cwt.

The manure of Treatments 1 and 2 was sown in a 3-in.-wide band, the fertilizer being distributed very close to the potato sets as they were planted in the furrows. In Treatment 3 the fertilizer was sown in a 9 in. – 12 in.-wide band, as is common practice. Germination counts were made on 13th August when the plants were well through the ground, but these did not show any significant differences in the number of misses in the various treatments. Therefore the close application of the fertilizers cannot be said to have affected the strike. In fact, the number of misses was greater in Treatment 3, where the fertilizers were distributed in a 9 in. – 12 in. band. At no time during growth could any differences be detected by observation.

The trial was dug and weighed on 28th October with the results shown in Table 3.

Table 3.—Results in P. A. Miller's Trial.

Treatment per Acre.	Yield per Acre.		
	First Grade.	Second Grade.	Total.
	Cwt.	Cwt.	Cwt.
(1) Super 15 cwt., sulphate of ammonia 4 cwt., in 3 in. band	90	16	106
(2) Super 15 cwt., sulphate of ammonia 4 cwt., potash 2 cwt., in 3 in. band	89½	16	105½
(3) Super 15 cwt., sulphate of ammonia 4 cwt., potash 2 cwt., in 9 in. – 12 in. band	86	15	101

The differences in yield were not significant. Although the difference between fertilizer in 9 in.–12 in. bands and 3 in. bands is not significant, the increase in favour of the latter has been consistent during the last three seasons. The difference was significant in season 1929, and amounted to 12·4 cwt. The use of 2 cwt. of potash has not given any increase in yield, which confirms the results in last season's trial on this farm.

Trial on E. J. Campbell's Farm.

The trial was carried out on a field broken up from a three-year-old pasture in the autumn of 1929. Two crops of potatoes were grown in the 1929–30 season, followed by two crops in the 1930–31 season. The field had only a poor turf to plough under in 1929. The experimental area was planted on 12th and 13th May, 1931. The experiment was laid down to further test the yield value of potash, and to discover the quantities of phosphates and nitrogen (sulphate of ammonia) most economical to apply. The manurial treatments per acre were as follows:—

(1) Superphosphate 14 cwt., sulphate of ammonia 4 cwt., sulphate of potash 2 cwt.
(2) Superphosphate 14 cwt., sulphate of ammonia 2 cwt.
(3) Superphosphate 14 cwt., sulphate of ammonia 4 cwt.
(4) Superphosphate 14 cwt., sulphate of ammonia 6 cwt.
(5) Superphosphate 11 cwt., sulphate of ammonia 6 cwt.
(6) Superphosphate 8 cwt., sulphate of ammonia 6 cwt.

The trial was weighed on 6th October, with the results shown in Table 4 (next page).

The first-grade potatoes were sold for £16 per ton. The addition of potash caused no significant increase in yield. Treatment 3 (super 14 cwt. and sulphate of ammonia 4 cwt.) is significantly superior in first grade and total yield to Treatment 2 (super 14 cwt. and sulphate of ammonia 2 cwt.), but Treatment 4 (super 14 cwt. and sulphate of ammonia 6 cwt.) is not significantly superior to Treatment 3 (super 14 cwt. and sulphate of ammonia 4 cwt.). A reduction of the amount of superphosphate from 14 cwt. to 8 cwt. per acre has not affected the yield to any significant extent.

Table 4.—Results in E. J. Campbell's Trial.

Treatment per Acre.	Yield per Acre.			Increase of First-grade Potatoes over Treatment 2.	Net Value of Increase per Acre over Treatment 2.
	First Grade.	Second Grade.	Total.		
	Cwt.	Cwt.	Cwt.	Cwt.	£ s. d.
(1) Super 14 cwt., sulphate of ammonia 4 cwt., potash 2 cwt.	47½	17½	65	7½	2 8 0
(2) Super 14 cwt., sulphate of ammonia 2 cwt.	40	16½	56½	..	..
(3) Super 14 cwt., sulphate of ammonia 4 cwt.	45½	17½	63	5½	2 13 0
(4) Super 14 cwt., sulphate of ammonia 6 cwt.	48	18	66	8	2 12 0
(5) Super 11 cwt., sulphate of ammonia 6 cwt.	49½	18	67½	9½	4 14 0
(6) Super 8 cwt., sulphate of ammonia 6 cwt.	46½	17½	64	6½	2 15 0

From a comparison of Treatments 1 and 3 it can be seen that, as in the two previous seasons' experiments on this farm, potash has not increased the yield significantly. The use of sulphate of ammonia has again given payable returns in spite of low prices for potatoes. The effect of diminishing the quantity of superphosphate used is on a par with the previous season's results. It would appear that the quantity of superphosphate can be fairly safely reduced to about 11 cwt. per acre.

TRIAL ON W. BUTTERY'S FARM.

The field selected for this experiment was skim-ploughed early in 1931 and disked during the autumn, and the potatoes in the experimental area were ploughed in on 12th and 13th May, 1931. The trial was laid down to further test the value of applications of potash under the usual method of broadcasting in the furrow, and also to test the value of predressings of potash. The treatments were as follows, all manure being applied in the rows with the sets, except where otherwise stated in the case of predressed potash :—

(1) Superphosphate 12 cwt., sulphate of ammonia 4 cwt.

(1*a*) Superphosphate 12 cwt., sulphate of ammonia 4 cwt., and predressing of sulphate of potash 4 cwt.

(2) Superphosphate 12 cwt., sulphate of ammonia 4 cwt., sulphate of potash 2 cwt.

(2*a*) Superphosphate 12 cwt., sulphate of ammonia 4 cwt., sulphate of potash 2 cwt., and predressing of sulphate of potash 4 cwt.

(3) Superphosphate 12 cwt., sulphate of ammonia 4 cwt., sulphate of potash 4 cwt.

(3*a*) Superphosphate 12 cwt., sulphate of ammonia 4 cwt., sulphate of potash 4 cwt., and predressing of sulphate of potash 4 cwt.

The predressings of 4 cwt. of potash were applied on 8th April, over a month prior to the planting of the trial. The experiment was sown in two adjacent blocks. Each block consisted of six replications of the treatments sown with the seed, crossed by three

strips of potash predressing alternating with three strips without potash. The potash strips of one block were opposite the "no potash" strips of the other block. Thus there were eighteen replications of each treatment in each block, giving in all thirty-six replications.

During growth Treatment 1 was observed to be very slightly superior to Treatments 2 and 3. The potatoes were dug and weighed on 15th October. No differences were observed due to the predressings. Results from the weighings are shown in Table 5.

Table 5.—Results in W. Buttery's Trial.

Treatment per Acre.	Yield per Acre.		
	First Grade.	Second Grade.	Total.
	Cwt.	Cwt.	Cwt.
(1) Super 12 cwt., sulphate of ammonia 4 cwt. ..	84	22	106
(2) Super 12 cwt., sulphate of ammonia 4 cwt., potash 2 cwt.	82½	20	102½
(3) Super 12 cwt., sulphate of ammonia 4 cwt., potash 4 cwt.	77½	21	98½
(1a) Super 12 cwt., sulphate of ammonia 4 cwt., and potash 4 cwt. predressed	82	23	105
(2a) Super 12 cwt., sulphate of ammonia 4 cwt., potash 2 cwt., and potash 4 cwt. predressed	75½	21½	97
(3a) Super 12 cwt., sulphate of ammonia 4 cwt., potash 4 cwt., and potash 4 cwt. predressed	75	23	98

Treatment 1 (no potash) is significantly better than Treatment 3 (potash 4 cwt.) in first-grade potatoes. Treatment 1*a* (potash 4 cwt. predressed) is significantly better than Treatment 2*a* (potash 2 cwt. with seed and potash 4 cwt. predressed) and 3*a* (potash 4 cwt. with seed and potash 4 cwt. predressed) in first-grade potatoes. It can thus be seen that there are significant depressions due to the use of potash in the furrow, the normal method of applying it. All predressings of potash also caused depression in total yield and in yield of first-grade potatoes, but these are not significant.

Recommendations to Pukekohe Growers for Early Crops.

(1) Use 8 cwt. to 11 cwt. of superphosphate and 4 cwt. to 6 cwt. of sulphate of ammonia.

(2) Altogether nine trials have been carried out during the last three years to test the value of potash on the early crop. These trials have shown little value in the use of potash.

(3) Growers using sulphate of ammonia should certainly lime their land after the potato cropping is completed in the rotation. About 1½ cwt. of ordinary ground limestone is required for every hundredweight of sulphate of ammonia used.

The writer wishes to record his thanks to Messrs. Campbell, Nicholson, Miller, and Buttery for their helpful co-operation in carrying out the 1931 manurial experiments.

SOME DAIRYING POTENTIALITIES OF THE SMALL FARM PLAN.

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IN the brief interval which has elapsed since the announcement by the Government of the Small Farm Plan abundant evidence has been provided that the intrinsic worth of the proposals is realized by thoughtful farmers. Every farmers' organization to which the plan has been explained clearly has expressed the opinion that it is at least better than any other scheme as yet submitted as a means of dealing with the present difficult economic situation. The opinion of prominent individual farmers is in conformity with that of their organizations. This has been well exemplified in the west coast area of Wellington Province and in the southern part of Hawke's Bay, where the services of several local advisory committees to co-operate with the Department of Agriculture were sought. Not a single refusal was received from the prominent busy men who were asked to give their services—services, by the way, which should be of great value in assuring the fullest possible success for the Small Farm Plan.

So far, so good. But it is evident that in some quarters there are misgivings about the amount of labour it is possible to absorb in an economic manner in our rural industries. Such misgivings seem usually to be based on the belief that, while additional utilization of labour would eventually be profitable, farmers to-day are not in a position to pay for additional labour from which profitable returns are to be expected only at some considerable distance in the future. Hence it seems well to consider whether there is not scope on our farms for the employment of additional labour from which practically immediate returns will be received. If it can be shown that there is such scope, then the grounds for the misgivings mentioned are correspondingly weakened.

For the present, consideration will be given only to that very important rural industry—dairying.

There is accumulated evidence that the actual milking of cows is not always done as efficiently as would be profitable, and that the commonest cause of inefficiency in this connection is scanty utilization of labour. The analysis of data secured through herd-testing and similar work has time and again pointed to the conclusion that many of the larger herds could with profit be split into two milking units. For example, herds of eighty and more cows are being milked on a share-milking basis. On the evidence available the owners of such herds would do well to explore the prospects of greater profits from the division of such large herds into two equal herds, employing two share-milking families in place of the one family under the present arrangement. Because of the extra labour that would become available thereby for such work as the growing of supplementary forage-crops and the conserving of surplus summer pasture growth, it is conceivable that the total number of cows in the two herds could be made greater than the number at present in the undivided large herd. It is to be

expected that the individual cows in the two herds would be more carefully and thoroughly milked than if they were all in a single herd.

Probably some owners of such large herds operated on a share-milking basis have at times considered the question of dividing their herds in the way just suggested, and, while realizing the advantages to be obtained, have been deterred from taking any action on account of the outlay involved in providing not only extra milking-plant, but also the necessary residence for the second share-milker. In many instances the outlay in this direction would bear more heavily to-day than formerly. Hence it is of particular importance that the Small Farm Plan in suitable circumstances may probably be employed to remove some of the financial difficulties that tend to arise in the dividing of undesirably large herds into two smaller more efficient ones. Farmers who are interested are therefore invited to consult the Small Farm District Organizers of the Department of Agriculture in regard to details which could not satisfactorily be discussed now.

In support of the view that the suggested division of large share-milking herds would prove profitable, there is the fact that an additional 600 lb. to 700 lb. of butterfat from each of two divided herds would be sufficient at current prices of dairy-produce to cover interest and depreciation on the milking-plant, to provide interest and sinking fund on the share-milker's house, and still leave a small amount on hand.

Another somewhat similar arrangement which would lead to increased efficiency in milking originates in the fact that practically all herds contain some cows which are difficult to milk or are otherwise unsuitable for milking by machines. It is considered that herd production would be materially increased by separating such animals from the main herd and hand-milking them as a separate herd-unit. It has been noted that herds of sixty to seventy cows at times contain from twelve to twenty animals which are difficult to handle on the machines—they often not only fail to produce to their best ability themselves, but hold up the progress of all the shed work. Such animals at times include some really good milkers. Experienced farmers generally believe that the best way of handling such cows is by a separate hand-milking arrangement. Yet this way is seldom adopted, because of difficulties of arranging the hand-milking. It is considered that a suitably located occupier of a Small Farm could at times be usefully employed part of his time to do the hand-milking on a share-milking or wage basis.

It would probably be difficult to overstress the importance of generally improving our milking efficiency. It is not merely a matter of obtaining greater direct production of butterfat from those animals which are difficult to milk out on the machines. That is really a minor matter in comparison with the effect improved milking would have on the incidence of udder troubles. In all important dairying countries udder troubles are a bane to the farmers, and in New Zealand experienced farmers and veterinarians are in hearty agreement in attributing this to a considerable extent to shortcomings in our machine-milking methods. For example, a qualified veterinarian operating in one of the most important dairying districts in the Dominion says definitely that much of the mammitis that comes under his notice would be avoided, or remedied, were the herds milked more

efficiently in the way that would be facilitated by the introduction of small hand-milking units attached to relatively large herds as already suggested. Hence those many dairy-farmers who rightly dread the ravages of udder disorders, should carefully consider the possibility of participating in the Small Farm Plan as a means of lessening the danger of avoidable losses from this cause.

There is a third important opening for the application of the Small Farm Plan to milking on farms the owners of which do not see their way to carry a full-sized dairy herd. There are, for instance, many sheep-farms or mixed farms on which dairy herds, say, of nine to fifteen cows, could be introduced with advantage, whereas herds of forty cows or more in number would be impracticable. There seems in such circumstances to be excellent openings for suitable small-holders settled in the vicinity to handle these small herds on a share-milking basis and do other available work besides.

The scope for utilizing the Small Farm Plan as a means of improving the general efficiency of the important work of milking is to some extent indicated by the fact that official statistics indicate there are some thousands of herds in the Dominion ranging over eighty cows in number. It may be said with confidence that to-day there is avoidable inefficiency in the milking of practically all these herds, and that in general more labour is the key to the avoidance of the inefficiency which costs our dairy industry very large sums annually in lost production.

Another dairying matter of even greater importance, and one in which the Small Farm Plan may be made to play a valuable role, is inefficiency in feeding practice. It has been demonstrated that thousands of our dairy-farmers do not feed their stock as well as would be profitable. Indeed, there is much evidence which points to the conclusion that by better feeding alone our dairy production could, within a single season, be increased by at least 20 per cent. It may truly be said, in fact, that the greatest and most urgent need of our dairying to-day is better feeding. Hence particular importance attaches to the fact that one of the most common causes of poor feeding is scant farm labour. Hundreds of dairy-farmers know that they are not feeding as efficiently as they should. They know also what they should do to increase profitably the efficiency of their feeding practice. But often they do not do what they realize they should do, because they cannot readily obtain the necessary labour.

Two of the more important measures which should more generally be adopted for the purpose of bringing about improved feeding in dairying are the growing of special crops, such as mangels, and the practice of ensilage. Both of these practices call for labour of the casual type, which could well be supplied by suitably located small-farm settlers. Within the next few weeks these practices will, on many farms, give occasion for such labour as the construction of ensilage pits or trenches, and the preparatory cultivation of land for suitable forage-crops.

In addition, better feeding is often dependent upon drainage and more fencing, which are at times not carried out because of paucity of farm labour.

In brief, paucity of casual farm labour often leads to failure to obtain increases in production which could be obtained not only profitably, but also promptly.

To sum up, the Small Farm Plan, if suitably employed, promises to assist materially in improving the efficiency of our dairying. This is possible because at present our dairying is inefficient in at least two important aspects. Firstly, there is considerable inefficiency in milking practice. Secondly, there is marked inefficiency in feeding practice. The inefficiency, both in feeding and in milking, may be attributed largely to unduly scant supplies of suitable readily available farm labour. The Small Farm Plan, if properly applied, offers a solution of the labour difficulties just considered.

Full information regarding the Small Farm Plan is available from District Organizers of the Department of Agriculture.

THE APIARIES ACT AND ITS PROVISIONS.

CONTROL OF DISEASE IN BEES.

E. A. EARP, Senior Apiary Instructor, Department of Agriculture.

THE notes which follow are presented with the object of outlining the main clauses of the Apiaries Act, and bringing them more prominently under the notice of all persons keeping bees. While the majority of beekeepers are, no doubt, aware of the provisions of the Act, it is probably safe to say that there are many who have never read them.

The Act was formulated on the principle that proper control by the State is best for the industry as a whole. It provides as far as practicable for the inspection of apiaries, and for the control of bee diseases and conditions which are likely to foster them. Past experience has proved that it is necessary for every beekeeper to do his part in controlling disease. Individual effort is largely nullified where it is counteracted by neglect on the part of others. Therefore the Act was framed to deal with the beekeepers who do not voluntarily treat diseased colonies. These will be found in practically every district. There are always careless or wilfully negligent persons in the community, and, as such individuals will not give their bees the necessary attention unless compelled to do so, legal means must be employed to see that the welfare of other beekeepers is safeguarded. When disease appears among the bees of the careless owner, and is allowed to remain untreated, such colonies are apt to become a menace to every other beekeeper in the neighbourhood.

The Act provides for the appointment of Inspectors to administer its regulations. These officers, however, do more than the Act specifies inasmuch as they act as Instructors also. A great deal of their time is taken up in educating beekeepers in the proper treatment of disease with regard both to season and method. Thus their scope is wide enough to include inspection for disease, treatment when it is discovered, instruction in general apiculture, and helpful advice in every branch of the honey industry.

It has long been recognized that the diseases of bees, besides being a serious matter to beekeepers, cause much loss to other members of the farming community. The honey-bee is perhaps the insect which accomplishes more than any other—the successful pollination of flowers so necessary for the proper production of fruit and seeds. It is an indispensable ally of the orchardist, gardener, and farmer. The beekeeper who gives his bees proper attention is a benefactor to his neighbours, since he fills gardens, orchards, and fields with willing workers; but, as he has no control over the flight of his bees, he must run the risk of their contracting infectious disease unless all the other beekeepers in the neighbourhood co-operate. Without efficient organization and a widespread knowledge of the destructive nature of the diseases affecting bees, it is difficult for even an efficient beekeeper to carry on successfully over a long period. He cannot take precautions against his neighbours' carelessness. His is a losing battle unless the State gives him legal protection.

The Apiaries Act, as its name suggests, aims at consolidating and amending the law relating to the industry in New Zealand. In addition to the machinery clauses, the Act provides for the compulsory registration of apiaries, forbids the keeping of bees in box hives, and compels the cure or destruction of all diseased bees and their hives. It also prohibits the removal of bees and appliances without a permit, treats the exposure of honey, wax, and materials from diseased hives as an offence, and requires beekeepers to notify the Inspector of the presence of disease within seven days after its discovery.

Section 5 of the Act deals with the registration of apiaries, and requires that no person shall keep bees except in an apiary registered under the Act. In addition, it makes any person keeping unregistered hives, or allowing them to be kept on his land, liable to a fine of £20. This compulsory registration provides the Inspector with a complete list of the beekeepers in his district—an immense help in carrying out inspectional work.

The provision that the keeping of bees in box hives is a breach of the law proclaims itself a wise measure. Only by providing the bees with movable combs can the beekeeper hope to keep a check on the condition of his colonies. Movable frames allow him to examine his hives easily, and to note at a glance the condition of brood, queen, and food-supply. No one can judge of these matters by merely looking at the entrances. Subclause (3) of this section is an important one, and should be known to every householder, as it provides for a penalty of £20 for allowing bees that may have become established in any other than a frame hive to remain after notice to remove them has been issued by an Inspector. Bees that have taken up their abode in houses, sheds, or other irregular shelters, must be removed or destroyed.

Another important section of the Act deals with the moving of bees and appliances from one location to another. No colonies may be removed without the written consent of an Inspector. This precaution is taken for the purpose of preventing the transfer of diseased bees to the neighbourhood of clean apiaries. Much harm has been done in the past by practices of this nature. Any beekeeper who moves colonies more than 10 chains without a permit, or fails to observe the conditions imposed by an Inspector, renders himself liable to a fine

of £25 on conviction of such an offence. The allowance of a range of 10 chains is mainly for the purpose of facilitating merely local readjustments of apiary-sites.

Section 8 of the Act requires the beekeeper in whose apiary disease appears to take proper steps to cure it and to prevent its spreading. He is also required to notify the Inspector in his district of its presence within seven days of the date on which he becomes aware of it. This latter regulation is also a wise precaution, inasmuch as it enables an Inspector to take immediate steps to control the disease and to prevent its spread to neighbouring beekeepers.

Section 9 deals with bees, honey, or appliances found to be diseased, and gives the Inspector authority to issue instructions as to their cure or destruction. The Inspector is also authorized to destroy any infected bees, honey, and appliances without notice if circumstances demand such action.

A further clause in the Act has reference to persons dealing in diseased bees and materials, or who expose honey, wax, combs, or appliances taken from infected hives or used in connection therewith, in such a manner that bees may gain access to such material. Until these materials have been thoroughly sterilized by approved methods they must be kept secure from the bees. Neglect of this precaution renders the offender liable to a fine of £50. No fine could be too heavy for this class of offender, for he may put a neighbouring beekeeper to endless trouble and expense through his negligence.

The foregoing are the main clauses of the Act which concern the beekeeper, and, while they make provision for inspection of bees by duly appointed Inspectors and compel treatment or destruction where disease is present, the work can be greatly assisted by every beekeeper becoming an inspector of his own bees. It is not sufficient to rely upon periodic visits from a Government Inspector to ensure that all is well with the bees. Seasonal examinations should be made, and whenever disease is found rigorous measures taken to combat it. The most serious disease, foul-brood, is such that any person of reasonable intelligence can usually detect it, and when there is any doubt on the matter an hour or two with an Inspector should be sufficient to give the beekeeper enough knowledge of the trouble and its management to ensure his success in eradicating it. Any person who is properly informed on up-to-date methods of beekeeping should be able to handle this disease.

The aim of the Department of Agriculture is to make every beekeeper competent to handle the everyday problems with which he is confronted. This it hopes to do, not by force, but by spreading useful knowledge wherever it is most needed. The Act provides the authority for dealing with the many important matters, and enables the Government to employ experienced officers to undertake any necessary enforcement. It is obvious, however, that the administration cannot hope to successfully cope with the immense amount of work—for financial reasons alone—without the reasonable co-operation of all owners of bees. The apiary officer of the Department is not a law enforcer until he is compelled to act as such, but is primarily an Instructor. It is preferable for all concerned that his services should be mainly utilized in the latter capacity.

STANDARDIZATION OF FRUIT-CASES.

Horticulture Division.

A FEW years ago the Canadian standard apple-case was adopted as the standard export case for New Zealand. So popular has this type of case become that there has been an increasing demand on the part of fruitgrowers generally for its adoption as the standard apple-package for local marketing purposes also. In giving effect to this demand, however, an altogether new range of cases must be devised.

In the first place, the principal object of the standardization of fruit-cases is to reduce the number of packages to the lowest possible number consistent with the safe carriage and efficient marketing of the different kinds of fruit, thereby lessening the worries of the grower, the sawmiller, and the buyer.

The points to be observed in effecting standardization include the convenience of stacking in ship, railway truck, &c., both as to the individual cases in a tier and also the length of tiers. Cases should be so designed as to definitely indicate how they should be stacked in a tier, or they should be square, thus making their stacking a matter of indifference, particularly when handled by inexperienced men. A proportion of cases that are nearly but not quite the same measurement each way are bound to be wrongly placed in a tier unless the position of stacking is indicated by a cleat such as applies to the export apple-case.

Although a number of cases of different capacity are necessary to meet the needs of the different kinds of fruit, they should be as far as practicable of a given length, so as to keep each tier uniform in this regard at least. The governing length in this instance is 19½ in.—the outside length of the Canadian standard case.

Specifications of Standard Packages for Fruit.

Kinds of Fruit which may be packed separately in the several Packages.	Dimensions in Inches, (inside Measurements).	Approximate Thickness of Timber in Inches.			
		Ends.	Sides.	Tops.	Bottoms.
Apples, lemons, oranges, or quinces	10½ × 11½ × 18	¾	5/16	¼	¼
Apples, lemons, oranges, or quinces	7¾ × 7¾ × 18	¾	5/16	5/16	5/16
Apples, apricots, nectarines, peaches, or plums	5¼ × 11½ × 18	¾	5/16	5/16	5/16
Apricots, nectarines, or peaches	2½ to 3½ × 11½ × 18	¾	5/16	5/16	5/16
Apricots, nectarines, peaches, pears, plums, or tomatoes	7 × 7 × 18	¾	5/16	5/16	5/16
Pears	4½ × 11½ × 18	¾	5/16	5/16	5/16
Pears	8½ × 11½ × 18	¾	5/16	¼	¼
Tomatoes	4½ × 7 × 18	½	¼	¼	¼
Tomatoes	4½ × 7 × 8½	½	¼	¼	¼
Cherries	3½ × 11½ × 14	½	¼	¼	¼
Cherries	5 × 10 × 11	½	¼	¼	¼

Again, there should be as great an interchange of timber as possible provided for between the sides, tops, and bottoms of individual cases as well as between the various cases of the set. As far as practicable all the foregoing points have been taken into account in designing the several cases that will appear in new regulations.

Although it is proposed to immediately standardize the range of cases shown in the accompanying table, the whole question will be brought before the next Dominion Fruitgrowers' Conference—not for the purpose of adding further types of case, but rather with the object of elimination so far as such may be considered advisable. The table gives details of the cases, as they will appear in the regulations, although possibly not in the same sequence.

DAIRY FACTORIES IN NEW ZEALAND, 1931-32.

THE following table presents the registrations of factories under the Dairy Industry Act as at 31st March last, together with the quantities of butter and cheese forwarded to grading-stores for export during the year ended 31st March, 1932, and the numbers of milk or cream suppliers to the factories during the same period :—

District.	Number of Factories.				Forwarded for Export, 1931-32.		Number of Suppliers to Factories.	
	Butter.	Cheese.	Dual Plant.	Total.	Butter.	Cheese.	Butter.	Cheese and Dual Plant.
					Tons.	Tons.		
Auckland ..	63	36	4	103	67,737	14,886	22,186	1,476
Taranaki ..	19	67	36	122	10,905	36,060	3,029	3,928
Wellington ..	19	47	9	75	11,001	11,673	6,220	1,704
Hawke's Bay ..	9	17	1	27	4,359	3,556	4,318	741
Nelson	5	3	1	9	1,410	450	1,071	724
Marlborough ..	3	3	2	8	711	864	764	200
Westland ..	10	1	..	11	430	27	640	8
Canterbury ..	11	13	2	26	1,518	1,412	6,918	494
Otago and Southland	10	76	1	87	1,477	14,371	6,261	3,264
Totals, 1931–32	149	263	56	468	99,548	83,299	51,407	12,539
Totals, 1930–31	147	270	59	476	93,971	90,960	46,906	13,839

Whey butter was manufactured as a side-line at eighty-five of the above cheese-factories in 1931–32, the total quantity forwarded for export being 1,422 tons. This is not included in the total amount of 99,548 tons of butter given in the table, which refers to creamery butter only.

In the 1931–32 period there were also operating in the Dominion five milk-powder factories (two whole-milk and three skim-milk plants), seven casein-factories, two condensed-milk factories, and one sugar-of-milk factory.

—*Dairy Division.*

Oats for Ensilage.—A number of crops of oats were harvested for ensilage in the Okato district of Taranaki last November. The method adopted is to cut with the reaper-binder and stack in the same manner as a sheaf stack, leaving the bands intact. This results in a very fine ensilage, with a minimum of handling.

SEASONAL NOTES.

THE FARM.

Winter Work on the Grasslands.

On some farms on which pasture is the dominant crop the work carried out in the winter is mainly that of a stockman or a shepherd. On such farms the live-stock may be closely and carefully watched; they may be shifted from field to field at suitable intervals. But little else is done. Judged in the light of full knowledge of what constitutes modern grass-farming efficiency, such farms as a rule do not rank highly. The competent grass-farmer has usually good cause for being, in the winter, much more than a shepherd or a stockman.

Internal Fencing.

On a great number of farms additional internal fencing as a means to more effective utilization of the growth of pastures could with advantage be erected. While this statement is not intended as advocacy of the "pocket handkerchief" class of paddocks which some seem to consider desirable, it is intended as advocacy of the provision of a greater number of paddocks than exist on many farms to-day. On all grassland of medium to good quality the practice of extensive grazing should soon disappear. While definite rules suitable for application in specific cases cannot safely be stated, on account of variations in circumstances, it may be laid down that most average-sized farms of land of medium to good quality could with advantage be subdivided into at least twelve paddocks. And it is easy to conceive circumstances in which a somewhat greater number of paddocks on individual farms would be well justified.

Incidentally, it is not usually necessary or even desirable that the main grazing fields on any farm should be approximately equal in size. In dairying many of the internal fences may quite suitably be of a relatively simple inexpensive type. Fences consisting of three wires with four posts to the chain at times serve quite well. Such fences are especially appropriate when the suitability of the site of a fence is to any extent under trial. The erection of new fences frequently provides further winter work in the provision of suitable stock-drinking facilities in any new paddocks which have been formed.

Ensilage Measures.

In selecting the site of new fences attention should be paid to the present or future location of ensilage pits or trenches. The mere fact that ensilage is not practised on a farm at present is not good ground for ignoring the possibility that it will be introduced in the near future.

While thousands of farmers know from personal experience the value of ensilage, there are still many farms to which it could be introduced with profit. This is especially true of sheep-farms, but it is also widely true of dairy-farms.

Although the stack system of ensilage has certain distinct merits and should often be adopted if circumstances do not allow of the use of pits or trenches, the fact that the latter can be used effectively much more commonly than is sometimes believed gives special interest to the fact that ordinarily the pits or trenches are more economical in respect both to labour and to wastage of material than are stacks. Two of the main matters to be considered in the construction of pits and trenches are

convenience of location and the avoidance in the excavated space of corners, which militate against the very desirable thorough packing of the material. Much useful information about trenches and pits is available in this Department's Bulletin 146, "Ensilage on the Farm."

Grass Harrowing and Top-dressing.

Grass harrowing is a task which commonly calls for attention in July. It should be so carried out as to lead to thorough breaking-up and even distribution of accumulated droppings. To obtain this result most readily it is usually advisable to harrow the land twice in such a way that the direction of the second harrowing is at right angles to that of the first. A brush harrow or a width of chain harrow attached at the back of the grass harrow proper assists in thoroughly distributing the droppings.

In the past much very effective top-dressing has been carried out in July. In some respects such practice is not as effective as pre-winter top-dressing, but it has been so effective over wide areas that it may be recommended with confidence to those farmers who have carried out a scant amount of pre-winter top-dressing. When, as is often the case, the quickest possible results are desired from the application of phosphates, then normally superphosphate should be used. Careful and extensive investigation indicates that over wide areas the influence of superphosphate applied to grassland in July is to be detected within a few weeks, and so July top-dressing may be expected to increase not only the growth in summer, but also that in the latter part of spring, when the feed available for stock is frequently injuriously scant.

Drainage and Miscellaneous Pasture Work.

Apart from new drainage work in progress, there is need at times in July to do maintenance work in respect to existing drains, which at least should be inspected periodically to ascertain how they are functioning. The winter at times provides good opportunities for determining how future drainage work should be carried out; usually it is easier to obtain reliable information about the fall of the land, &c., when the land is in a waterlogged condition than when it is comparatively dry.

All possible steps should be taken to avoid trampling of wet, soft paddocks by stock in winter. Such trampling at times leads to substantial permanent damage to pastures. Damage arises not only because of the burial of valuable plants, but also because of the formation of bare patches of ground upon which persistent weeds, such as rushes, buttercups, and daisies, at times become established. When damage from trampling cannot be avoided it may be sound to concentrate it upon a worn-out pasture which it is proposed to put under the plough at no distant date for the purpose of eventually renewing it. When such a paddock is available winter feeding-out of hay, roots, &c., should be done on it as far as can be arranged conveniently.

Pastures which have been attacked by the grass-grub, if not so seriously damaged as to call for renewal, may advantageously have hay and roots fed out on them. At times the seeds in hay bring about a considerable amount of reseeding, and the trampling of the stock makes the position less favourable to the grubs.

It is as a rule advisable to clean up and spell certain paddocks in June and July in order that they may provide fresh suitable feed for the early part of the milking season. The paddocks so treated should preferably be well drained ones supporting a sward containing a good deal of rye-grass.

Crops auxiliary to Pasture.

Frequently the best returns possible from pastures are not obtained unless crops to serve as auxiliaries are suitably grown. One of the most important weaknesses in New Zealand farming lies in the fact that insufficient quantities of such crops are usually grown. Hence it is of particular current moment to remember that the crops other than grass which are to be grown during the coming season should be decided upon without any great further delay. Useful guidance regarding the cropping programme suited to supplement the pastures most profitably has been provided by the farmers' field-crop competitions, which have extended over many seasons and embraced a wide range of conditions.

These competitions provide conclusive evidence that on good average soils the mangel is not grown as extensively as it very profitably could be employed. During the three latest seasons in respect to which information is available the average yield of 244 crops which came under notice was 58 tons per acre. This result strikingly demonstrates the outstanding value of the mangel as a cheap source of winter feed. If hay is worth £3 a ton mangels are worth at least 10s. a ton, and on this basis a 58-ton crop of mangels is worth £29 an acre. It may with much truth be contended that the yield of the mangel as commonly grown is much nearer to 30 tons than to 60 tons per acre. But, as has been shown by the field competitions, there is no essential reason why farmers should continue to be satisfied with such low yields. It is known from extensive experience not only that success with the mangel is associated with good treatment, but also that early preparatory cultivation is an important component of this good treatment. As the mangel responds strikingly to all-round good treatment, the land devoted to it should be characterized by the highest possible fertility, whether natural or induced by manuring. Hence it is often advisable to dress liberally the future mangel area with any organic manure available from sheds, &c. When possible such organic manure should be applied before the land is ploughed. As preparatory cultivation for mangels should frequently be in progress in August, it follows that the distribution of the organic manure on the mangel area may at times well be undertaken in July.

The field competitions also demonstrated the potentialities under good management of the swede, which does not demand such high fertility as does the mangel: the average yield of 283 swede crops which came under notice in three recent seasons was 40 tons per acre. As a ton of swedes is approximately equal in feeding-value to a ton of mangels, a good average crop of swedes thus has a cash value of £20 per acre when the value of hay is fixed at £3 a ton—a return which surely suggests that in many localities swedes could with distinct profit be grown more widely. Particular importance attaches to the fact that a profitable swede crop may be the intermediate step to the improved permanent pastures obtainable by the use of seed mixtures containing appropriate quantities of true perennial ryegrass and good types of New Zealand white clover and cocksfoot.

Preparations for Lucerne.

Another very useful crop which has been much neglected and which warrants mention at this season is lucerne. If preparatory cultivation for lucerne is not already in progress it should be commenced at an early date. New Zealand experience simply confirms that of other countries by showing what a definite misconception it is to hold that lucerne is specially exacting in its requirements—a misconception so common that it is largely responsible for lucerne not being so widely exploited as is warranted by its intrinsic worth. It has been shown that lucerne can be grown profitably on practically all types of naturally well-drained soils.

Lucerne may well follow old pasture, and if this is done, then the land should be skim-ploughed well ahead of the time of seeding and subsequently ploughed deeply once only, so that weed seeds occurring in the surface layer may be covered with such a depth of soil that they will remain dormant, provided they are not by later cultivation brought back to the surface layer. Detailed guidance regarding lucerne management is available in this Department's Bulletin 155, "Lucerne on the Farm."

The results of the recent dry season should have served well to demonstrate the outstanding value of lucerne in districts which are subject to seasons of light summer rainfall.

Tillage for Spring-sown Cereals.

In general, in the latter part of June and in July seed-sowing should be avoided, but as spring oats and wheat are usually sown in August and September, and barley in September or early October, it is most advisable in June and July to make all possible progress with the tillage work in preparation for these cereals. In July, however, on heavy types of soil there is often so much water present that tillage would be injurious. Injury to the soil may be expected when the soil freely clings to boots or implements that pass over it, and when this happens cultivation, even though it is urgent, should be deferred. At times ploughing of old pastures may safely be carried out when ploughing of adjacent land which has been under cultivation recently would be injurious because of its wet condition. Ploughing of grassland should cease when the soil is so wet that furrows with a glazed-looking surface are produced. If land ploughed in the autumn has settled down firmly during the winter it should often be ploughed again in preparation for a spring-sown cereal.

Winter Feeding of Stock.

In general the regrettable shortage of winter feed which is commonly experienced year after year will be felt more acutely this winter than is usual. Hence it is worth noting that immature developing animals are likely to suffer more than mature stock. In the case of the developing dairy heifer, the direct result of inadequate winter rations may readily be a stunting of growth having a permanently harmful effect on yield. Hoggets also suffer severely from hard winter treatment. Hence it is usually profitable to give both of these classes of stock the best feed available.

The dairy cow should be treated so that she may be able to utilize the period when she is not being milked as a period of recuperation and renewal of bodily reserves, which are specially apt to be depleted in the case of heavy producers. If at all possible the feeding during winter of straw or of other inferior coarse feeds to all these types of stock should be avoided. It may be advisable, however, to maintain dry dairy cows on such coarse feeds if this is the only means of making available leafy grass or similar feed for the cows when they have calved.

The feeding of roots and silage together in considerable quantities should when possible be avoided. They are both relatively bulky, watery feeds, which tend to balance well with hay of good quality. Silage alone has been fed with definitely successful results right up to calving and lambing time, and it seems a moot point whether the results would have been better had some hay been used.

Cereals sown in the autumn should be fed off before the growth becomes markedly long; two feedings of relatively short growth are likely to be less wasteful and generally preferable.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Pruning.

PRUNING will be the chief occupation at present, and growers should keep it well in hand so that it may be completed before the spring work begins to pile up. Where it is necessary to make large saw-cuts they should be trimmed and covered with coal-tar or paint to prevent the entry of rotting and other fungi and to assist in the process of healing. Prunings should not be left about, but collected and burned. Many growers now use pruning sheets, from which the prunings are tipped into heaps for burning.

Grafting.

The limbs of trees it is intended to graft should now be cut back to within a foot or so of where it is intended to work them. Now is also the time to collect scions for grafting. Care should be taken in their selection, well-developed wood of the past season's growth which is not too thick—say, the thickness of an ordinary lead pencil—will be the most suitable. These scions should be placed in a shady place, covering fairly deeply but not so as to actually bury them.

Manures and Cover-crops.

Soils are made up of inorganic matter, the so-called inert materials (minerals), and organic matter, which is the product of decay of once living animals and plants. This latter is the humus of the soil, and in it is contained most of the nitrogen. Exhaustion of the soil may be caused by climatic conditions, improper cultural practices, leaching or washing out, and by continuous cropping with the same plant or class of plant. Excessive summer cultivation, especially in a hot dry climate, will destroy the organic matter in the soil and so dissipate the nitrogen content. Where agricultural crops are grown, a rational system of rotation helps considerably to conserve the necessary plant-foods. Fruit-trees essentially differ from other crops in various ways. They have a greater root area and therefore a wider range to forage in. On the other hand, there can be no rotation of cropping, as the trees occupy the ground for many years and are therefore making a demand on the same plant-foods in much the same proportion year by year.

It is not always safe to predict what manure a crop requires; indeed, whether it is a manure or some other treatment, such as more water, better cultural conditions, &c., which are necessary. Other things being equal, it may be taken that nitrogen is needed if the trees are making poor annual growth, especially terminal growth, and if the leaves are small and light in colour and the fruit small. In other words, if the tree looks starved and stunted nitrogen is probably deficient. Again, if the crops are poor in quality and quantity the cause may be traced to the lack of phosphoric acid or potash or both.

Those ingredients which are unduly removed by the crops are returned to the soil by the application of farmyard manure, green manures, or artificial manures. The available supplies of farmyard manure are, unfortunately, too limited for general application.

Green manuring or cover-cropping is the growing of crops essentially for the purpose of incorporating them with the soil. It is primarily practised to increase the humus or decayed vegetable matter in the surface soil. It also brings up plant-food which is more readily available when the crop decays, and is ploughed under, than it was in its original state in the soil. If a leguminous crop such as lupins, peas, beans, vetches, clover, &c., is utilized, a considerable amount of nitrogen is obtained free from the air. A soil well supplied with humus is a soil well supplied with

nitrogen. Humus itself holds stores of phosphoric acid and potash as well as nitrogen. During its decomposition it also liberates all plant-food to be made available for use. A considerable portion of the potash, lime, &c., used by plants is furnished in this way. Humus increases the absorptive and retentive powers of the soil with regard to moisture. Humus keeps the soil in a more equable temperature, warms it in winter and cools it in summer; it opens up stiff soils and binds light ones, and is a potent factor in the prevention of loss of manurial materials by drainage. The chief value of legumes over cereals is their capacity to obtain the most expensive manurial ingredient—nitrogen—free from the air by means of the nodules on the roots. They are, also, deeper rooting and are able to avail themselves of a food-supply from the lower soil which, as already explained, is brought up and made into a more available form for the use of the trees. The great need in many of our orchards to-day is the revitalizing of the soil by the turning in of leguminous crops.

Artificial fertilizers are materials that furnish, in a more or less available form, one or more of the three so-called essential elements of soil fertility—nitrogen, phosphoric acid, and potash. Fertilizers are used to supply these elements to the soil in a condition available, or nearly available, for the use of the plant, but must be used in conjunction with good tillage practice and the efficient supply of humus and moisture in the soil. The best way of supplying nitrogen is by turning in a leguminous crop and supplementing it with an application of sulphate of ammonia in spring and early summer. The amount per acre will vary, according to the needs of the tree, from 1½ lb. up to 4 lb. or 5 lb. per tree. Phosphoric acid is largely supplied in the form of superphosphate applied in autumn, winter, or very early spring, at rates varying from 2 lb. to 6 lb. and even more per tree, portion of which should be applied with the sowing of the green crop. The general form in which potash is added to the soil is in potash salts, muriate of potash, or sulphate of potash, the latter being usually given the preference, at the rate of 1 lb. to 3 lb. per tree; portion of this should also be applied with the green crop.

At present actual quantities per tree for the different classes of fruits in different districts cannot be stated. However, what little local experience there is available, together with the assistance of the Orchard Instructor for the district, will help very materially in selecting the right mixture.

Miscellaneous.

With the spring not far away, growers are urged to get their spraying plant in good working-order for the heavy calls to be made upon it during the coming season. A thorough cleaning and overhaul, with the renewal of worn-out parts, hoses, &c., is essential in order to avoid the heavy losses often sustained through break-down delays.

In the orchard nursery the ground should be kept free from weeds, and when the soil is in a fit condition a light hoeing will be beneficial.

Usually little is done in the way of working the ground in winter, but with the coming of spring everything should be renovated and made ready for the labour ahead.

—*W. R. L. Williams, Orchard Instructor, Alexandra.*

Citrus Culture.

It should not be necessary to remind growers to have everything in readiness to combat frosts where they occur during the late winter. Instructions were given in the May notes of last year. It will no doubt be contended by some that frost-fighting does not pay, but this is a very short-sighted view to take, and will not bear the light of common-sense business methods. Up to the present time a good deal of material and

labour will have been used in order to bring the fruit up to the marketable stage, and then, because it will cost an extra £10 or £20 to protect the crop, too often nothing is done. The frost may come and destroy only £20 worth of fruit, but the loss is in reality very much greater. The trees may and will suffer, and thereby affect the crop of the following season. There is, moreover, a likelihood of the loss becoming more extensive than this, owing to the fact that some growers often market fruit which has been slightly cut by the frost, and this will be reflected in the subsequent demand. It is well known that fruit damaged by frost loses most of its juice content, thereby making it of little or no value from a commercial viewpoint. Growers should always exercise great care in this regard and refrain from marketing any fruits that may be affected. However, the best course to follow is to prevent as far as possible any damage occurring by using frost-fighting appliances. Those who have made efforts in this direction have been well repaid.

Where new plantings are being carried out all preparatory work in connection therewith should be receiving attention.

Seasonal operations in the groves will consist in cleaning out drains, trimming shelter-belts, and harvesting of the fruit.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Mating-up the Breeders.

THE correct season for hatching and rearing young stock is now near at hand, and this implies the necessity for getting the birds mated up at an early date. To ensure a high proportion of fertile eggs containing strong germs the birds should be put together some time before eggs are required for hatching purposes. When pens are first mated up it frequently happens that the male bird will exhaust himself and it may be some weeks before he regains a condition in which to produce even a fair proportion of fertile eggs. This may cause the postponement of the hatching period, probably through the inability to secure a fresh male, or through other causes. It is always good policy to have a spare male as a standby.

Where large numbers of chicks of the heavier breeds are required, such as Orpingtons, Rocks, Wyandottes, &c., no time should now be lost in placing their eggs in the incubator. Where it is intended to bring out only a small number of chicks the hatching of the heavier breeds may be delayed until August. In the case of Leghorns and breeds of a similar type, it is best to hatch these towards the end of September. If profitable stock are to be produced, and the pullets are to lay during the following dear-egg season, the necessity for attention to every detail that will ensure having the full complement of chicks hatched out by the end of September, or early in October at the latest, cannot be too strongly emphasized. It is always better to be a month too early than a month too late. Chickens hatched late are always unsatisfactory, but with the present high cost of food they may easily mean a loss to the poultry-keeper.

Of late, fresh eggs have sold at high prices, and many producers have asked why their fowls have failed to lay. The answer is a simple one. Either the pullets have been hatched too early and have gone into a moult, or they have been hatched too late and will come into profit only when the egg-market is declining. It goes without saying that even stock brought out at the right time will not lay well, especially during the winter, if they are not fed and managed to the best advantage.

Points in Mating.

Mating birds with a view to increasing egg-production is without doubt the most important part of the poultry-keeper's work, because on the stock produced largely depend the profits to be made from his future flock. Fowls, like any other class of live-stock, can only be improved, or their existing good qualities maintained, by careful selection and breeding from fixed types of purebred stock. The chief objection to breeding from varied types, or crossbred birds, is that it invariably destroys fixity of type, and opens the door to reversion and the appearance of latent undesirable characters. It is therefore imperative that great care and judgment be exercised in choosing for the breeding-pen the best specimens possible.

In previous notes breeders were advised to select the required hens—the late moulters—for this season's breeding-pens before the moulting process set in, for it is then and only then that the best specimens for breeding can be determined. It is at that period of the year that certain signs manifest themselves in a striking manner whereby the good layer can be distinguished from the poor one. Usually at this period of the year the long-season layers, and naturally the late moulters, possess a more desired type and stronger constitutional vigour than the early moulters, and therefore it is from the late moulters that the breeding specimens should be selected. Where the timely advice was acted upon, and the late moulters and best breeding types were selected and marked accordingly—say, late in March—the work of mating will now be a simple matter. On the other hand, where the choosing of the breeding females has been left until the flock has moulted, the accurate selection of the most desirable hens will be found to be a matter of great difficulty. Indeed, in most cases it will be found an impossible task, as obviously when a flock has moulted and all birds are in a similar condition so far as their plumage is concerned it is impossible to distinguish between the early and late moulter, except, of course, where they have been specially marked to indicate this point. The poultry-keeper who has neglected to select his late moulters during the autumn may expect a high proportion of unprofitable stock as a consequence.

While lateness of moulting can be generally accepted as indicating good producing-power, it is not to be inferred that all late moulters are suitable specimens for the breeding-pen. Something more is required. If a heavy-producing strain is to be built up or maintained it is imperative for the poultry-keeper to have pictured in his mind a definite type, and to aim for this at all times. As before indicated, breeding from birds of mixed types merely because they possess good laying-points, or even an ancestral high egg-yielding performance, will never tend towards reaching the desired end. Sometimes birds of inferior type will prove good layers, but in a general way such stock have not the power to transmit their laying-qualities to their progeny, and are thus undesirable for the breeding-pen.

In making the final selection, even where the late moulters are concerned, every bird should be carefully examined in order to ensure that it is healthy and possesses undoubted constitutional vigour. No matter what other good points a bird possesses, whether it be male or female, if there is the slightest constitutional taint it should be rejected from the breeding-pen. Health and vigour form the base of all successful breeding-operations. Points indicating these essential requirements are a clean face free from wrinkles and feathers, clear, bright, prominent eyes, short shanks set wide apart, alert carriage, and tight glossy plumage, together with a well-developed crop. The question of size is another important matter. All birds conspicuously under or over the weight clauses specified in the New Zealand Utility Poultry Standard should be rejected. It is,

however, better to have a good big bird than a good small one. No matter how well they have laid, diminutive specimens of their breed should not be used for breeding. Such stock usually produce weedy progeny which yield only second-grade eggs. The small ones will come soon enough without specially breeding to secure them.

In mating fowls the aim should be not only to breed from those birds which lay the most eggs and which possess points indicating breeding-power; in addition, they should produce eggs of good marketable size—that is to say, of at least 2 oz. The production of small eggs is probably the greatest weakness in connection with present-day poultry-keeping. If any argument is required to prove that this contention is correct, it is surely borne out by the fact that in our export shipments of eggs those weighing less than 2 oz. have to be included in order to remove any surplus from the local market during the flush season of the year. The size of the egg can be increased only by careful breeding, and by the selection for breeding of only those birds that lay large eggs. In breeding to renew a laying flock pullets should not be used if it can be possibly avoided.

The Breeding Male.

It should be unnecessary to emphasize again the importance of choosing a sire of undoubted constitutional vigour, and that where eggs are the objective he should be descended from a strain of heavy layers. Feminine characters should be looked for in the female, but the sire should be practically the other extreme, though coarseness is not necessarily an indication of stamina. In addition, he should conform to the standard weight of the breed he represents. He should be active and of striking carriage. The other points in his make-up, such as a bold eye, clean face, broad back, legs well apart, and tight feathering, should be well enough understood—indeed, given the essentials first described, the minor points will necessarily follow.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

The Dormant Season.

DURING the months of June and July activities in the apiary, so far as the bees are concerned, should cease. No advantage is to be gained by interfering with the bees, providing the colonies have been left with ample stores, queen right, and well supplied with mats to conserve the heat of the cluster. After heavy rains it is advisable to remove the roofs to ascertain the conditions of the mats, and if any are found to be damp they should be removed. This can be done without disturbing the bees. Damp mats should not be tolerated, as they are harmful to the health of the bees at all seasons of the year, and more particularly during the winter months when dormant colony conditions obtain. As advised previously, a plentiful supply of mats should always be on hand.

Moving of Bees.

Providing sufficient care is taken, bees may be moved long distances with perfect safety at this season. It is not advisable to delay this work until the spring, as brood-rearing will then have commenced in earnest, and the numerical strength of the adult bees will be greater than at this period. Moreover, there is little brood in the hives to be injured. When moving bees short distances—say, up to a couple of miles—little preparation is necessary beyond screening the entrance with wire gauze, and fastening the bottom-boards and roofs with crate staples or battens. It is well to choose a cold night before closing the entrances of the hives to be removed. On arrival

at the new location the bees should be allowed to settle down prior to removing the gauze. It is quite a good plan to place some obstruction—a piece of board will suffice—in front of the entrance, as this will cause the bees to investigate and take new bearings. Some such action is necessary to prevent the field-bees from returning to the old location.

When removing bees long distances, which may necessitate their confinement to the hives for a lengthy period, it is essential that they be well packed so as to allow of ample ventilation. To safeguard against suffocation of the bees the hives require to have wire screens top and bottom. The screens can be made by using narrow laths nailed together to form a frame of the same dimensions of a hive-body, and covering this with wire cloth. When placing the screens on the hives proceed as follows :—

The evening before removal, after the bees are all in, place a frame alongside each hive level-side up. Gently lift the hive on to the frame. Next remove the cover and mat, and place the upper frame level-side downward in position. The bees being now secure, the battens to hold the frames can be nailed on the following morning. Place a hive-cover over the frames in the event of rain falling during the night. When railing bees, the frames should run parallel with the truck, but with road transport the reverse is the case. This rule should be followed to prevent the frames from rocking and thus killing the bees.

It is well to remember that (as a precaution against the spread of disease) bees cannot be removed a distance of more than 10 chains without the written consent of an Apiary Inspector. Failure to obtain the necessary consent renders a person liable to a fine not exceeding £25.

The Winter Overhaul.

During the winter months, as opportunity offers, the working plant of the apiary should be carefully overhauled. The engine or motor, extractor, and tools require to be examined, and defective or broken parts replaced, so as to have all in readiness for next season's work. It is not wise to leave the repairing and painting of spare roofs, hives, and bottom-boards until they are required to be brought into use. Now is the best time to lay down future plans ; and if an increase in the number of colonies kept is decided upon, or the establishment of an out-apiary is being considered with the object of increasing income, no time should be lost in getting together the required number of extra hives, supers, roofs, and bottom-boards, also in the preparation of frames and the fitting of comb foundation.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

THE land for onions should now be clean and in fine condition. When sufficiently dry it can be rolled and given a dressing of fertilizers ; 5 cwt. of equal quantities of bonedust and superphosphate per acre, or 2 oz. to the square yard, harrowed in, will be found suitable in many instances. Mark out the rows 1 ft. apart and set out the plants from seed-beds sown down in the autumn. Shallots and garlic should also be planted ; and towards the end of July lettuce, cabbage, and cauliflower plants may be set out in many districts where growth has commenced.

As slugs are serious enemies of some of these crops, it will in some cases be advisable to destroy the pest shortly before planting by broadcasting a poison bait of Paris green and bran, 1 part to 28 parts by weight, mixed well and then made damp with water. It should be broadcast thinly towards the end of an afternoon. When slugs are seriously attacking established plants a

dusting with powdered alum during a moist evening when they are feeding will destroy them. Or the alum may be mixed with twice its weight of slaked lime.

At the same period, towards the end of July, the salad crops of mustard, cress, radish, and lettuce may be sown, also spinach and an early sowing of peas. In warm localities early potatoes may be planted, and in any case seed potatoes should now be given air and light ; this will steady the growth of the young shoots and cause them to make more thrifty growth when planted.

Soil that is deep, rich, moist, and sandy is the natural home of the edible asparagus, and any garden which can provide conditions approximating this specification should have a generous area devoted to this useful crop that is harvested when few other vegetables are available. Good plants for the purpose may be grown in twelve months if the seed is sown as soon as growth commences. Sow the seeds thinly, so that plants will stand 3 in. or 4 in. apart, covering them with about 2 in. of soil. The drills may be 18 in. apart, and wider if motor or horse implements are used for after-cultivation. Five pounds of fresh seed should provide sufficient plants for setting out an acre of land ; but as careful grading is recommended more seed should be planted to allow for culling all inferior plants and setting out only vigorous plants of good type. By sowing early such plants may be obtained for setting out a permanent plantation about the month of August, twelve months after sowing.

Established crops of spring cabbage and cauliflower will now benefit from a small dressing of nitrate of soda. If a little potash is also included with these spring dressings the results will often be better.

Where plantations of rhubarb are to be lifted for division and replanting in newly prepared ground the surplus roots may be forced now. The remainder should be cut up into pieces, each having one or two good buds, and planted with the crown about 2 in. beneath the surface ; 2½ ft. apart for the Linnæus varieties generally grown is sufficient. Shortly before planting, a soil dressing of an ounce or two of bonedust and superphosphate to the square yard should be made. Every opportunity offered by fine weather should be taken to complete the preparation of the land for other early crops to be sown during August.

Small-fruit Plantations.

An application of bordeaux spray shortly before growth commences should be made to all bushes and canes ; 8 lb. of bluestone, 6 lb. burnt rock lime, and 40 gallons water is a recipe that has given good results. Where small quantities only are required, 13 oz. bluestone, 10 oz. rock lime, and 4 gallons water may be used. To prevent the attack of bud-moth and other larvæ, arsenate of lead may be added, after it has been worked up into a cream and diluted. Two ounces of the paste or 1 oz. of arsenate of lead powder should be added to each 4 gallons of spray. Freshly made and thoroughly applied in dull weather without wind, good adhesion will be obtained with this spray with maximum efficiency.

Tomato Crops under Glass.

As soon as the first true leaf is out the seedling plants must be pricked out into boxes of fresh soil ; this should be a well-prepared compost of fresh loam with sufficient humus to retain moisture and sand to keep it open. If it is light a little bonedust may be added, but no other fertilizer should be used. Handle the plants carefully and set them deep almost up to the seed leaves, and firm the soil about the roots. Where transplanting is only done once, give them plenty of room 2 in. or 3 in. between the plants is the usual distance. When the box is planted, water well with tepid water through a fine sprinkler, and place the boxes back

on the hot-bed. Keep them rather close, and abstain from watering again until growth recommences; then air must be given on all suitable occasions, but cold draughts carefully avoided. A full measure of success depends chiefly on maintaining these conditions, so that sturdy growth is obtained without interruption.

In preparing the boxes for pricking out place a little strawy manure in the bottom, fill the box with soil and firm it well, giving special attention to the corners. The surface should be about ½ in. below the edge of the box. To facilitate the work and ensure uniformity, a marker made of a board with pegs at the required distance, may be used. The plants are then set at the right distance, and each box, if they are of uniform size —as they should be—will contain the same number of plants.

The Homestead Garden.

The present time is most suitable for any remodelling that may by necessary in the homestead garden. Many gardens could be greatly improved in appearance, or more economically managed, by carefully considered alterations at the present time. Each garden, of course, has its own special problems, but in some instances where specimen shrubs and trees or flower-beds have been rather too generously placed about a lawn, they may be removed and the soil made firm, the surface graded and neatly laid down with fresh turf. This not only secures the restful appearance of a wider unbroken lawn, but makes it much more easily managed. In the same way borders may be narrowed or reshaped.

The most common mistake in our designs is to rather overlook the necessity of a general classification of the main features. Too often the vegetable crops and fruit-trees, the shrubbery and the herbaceous crops are interplanted, with the result that they are neither profitable nor attractive. A little may be done in this way sometimes with satisfactory results; but in the main these are quite distinct departments, and a general recognition of this fact will greatly facilitate the working and increase production in our gardens. Land planted in fruit-trees of full growth and at the usual intervals is best given over entirely to them. One or two fruit or nut trees may sometimes be planted in a shrubbery, or as an isolated specimen on the lawn with good results. Lemons are often found growing quite happily under such conditions; but vegetable crops should have an open situation that is well-sheltered specially devoted to them.

The herbaceous flowering plants, annual or perennial, with a few exceptions, should also be given separate quarters, so that they may receive the special treatment they require. Such beds or borders may now be made or remade, for this is necessary every four years or so. Lift out the plants and heel them in in a piece of vacant ground in the kitchen garden, carefully affixing labels where necessary. Then trench the beds and borders, working in a generous dressing of manure in the bottom of the trench, and bonedust, &c., in the top spit. When it has all settled down replant with the material that has been heeled in. If this opportunity is taken to thoroughly clean the land, and to work out a good planting arrangement, the results are better and the further labour required is reduced to a minimum. This treatment should be given periodically.

—*W. C. Hyde, Horticulturist, Wellington.*

Prize Lucerne Hay.—The method used for curing the lucerne hay which won first prize at last year's National Dairy Show, Palmerston North, was as follows: The lucerne was cut, allowed to lie for two days, and then put into cocks 3 ft. to 4 ft. high. These were allowed to settle, then one cock was placed on top of its neighbour, so making a number of substantial cocks in the paddock. A cover was placed on top of each, and the lucerne was allowed to remain until thoroughly cured. It was then stacked.

WEATHER RECORDS: MAY, 1932.

Dominion Meteorological Office.

MAY was a dry and cool month for the Dominion as a whole. The first few days, however, were mild, and since most districts had experienced good rains there was fair growth of grass. Strong winds occurred on a few days only and sunshine was plentiful. The effects of the cold spells of the middle and latter end of the month, which were severe for the time of year, were therefore considerably mitigated.

Rainfall.—Over much the greater part of the country rainfall was 25 per cent. or more below the average. The northern portion of the Auckland Peninsula, scattered parts of the districts between Hawke's Bay and the Bay of Plenty, an area extending from both sides of Cook Strait through eastern Nelson and Marlborough to North Canterbury, and Stewart Island, however, had more than the average.

Temperature.—Except in the western portions of the South Island, temperatures were everywhere below normal, though the departures were not large. It is most probable that the low temperatures were due to the presence in the atmosphere of volcanic ash transported from the Chilean volcanoes which erupted on 10th April. Brilliant sunsets are reported from all parts of the Dominion. In the South Island frosts were numerous from the 10th onward, many of them being severe. The hardest occurred on the 25th, and on this occasion practically the whole of the country was affected. At the end of the month temperatures were again low.

Sunshine was considerably above the average at most stations.

Winds.—There was a preponderance of southerly wind, and, as is usual in such cases, the average velocity was light. A northerly gale blew in Taranaki and Wellington and the northern part of the South Island on the night of the 9th. On the 25th most places experienced a south-westerly gale.

Pressure Systems.—At the beginning of the month a depression had just crossed the northern portion of the North Island, and on the 1st and 2nd some heavy rains fell in eastern districts between Cook Strait and East Cape before the depression moved away. Fine weather was then the rule until the 9th. On that day a deep westerly depression was passing to the south of New Zealand, and on the next a cyclone centre developed in the northern portion of it. This centre was located to the west of the South Island, and it was not until the 14th that it passed finally away. Heavy rains fell over most of the South Island and in Taranaki on the 10th, accompanied in some cases by severe thunderstorms. In South Canterbury the total fall over two days over a considerable area exceeded 4 in., and there were high floods. A heavy snowfall occurred in the Mackenzie Country, a fall of 18 in. being recorded at Fairlie and the Hermitage. There were lighter falls also in Otago, while hailstorms occurred at coastal stations. The gale on the 10th has already been mentioned. The weather remained unsettled until the 15th, the area of heavy rains moving gradually northwards. On the 13th to 14th there were floods in Kaikoura. On the 12th the southern portion of the Auckland Province experienced thunderstorms and heavy rains.

On the 22nd another cyclone developed rapidly in the Tasman Sea. Rain was again almost general, with many heavy falls. This storm moved away fairly quickly, and was followed on the 24th by cold south-westerly winds. On the 25th the winds freshened to gale force and a bitter day was experienced. Hailstorms were widespread, and accompanied in some places by thunderstorms. Snow fell at many

places in the South Island and in the interior of the North. Tokaanu reported the heaviest snowfall seen in the district for ten years. The rest of the month was mainly fine, but the last day or two were very cold.

Westerly depressions were very poorly developed during the month.

RAINFALL FOR MAY, 1932, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	2·86	14	0·64	6·86
Russell	7·37	20	1·21	7·05
Whangarei	6·33	24	1·09	7·95
Auckland	3·35	17	0·75	4·66
Hamilton	3·93	13	1·26	4·72
Rotorua	5·40	9	1·80	5·72
Kawhia	3·39	13	0·88	5·42
New Plymouth	4·61	11	1·23	6·21
Riversdale, Inglewood	7·65	13	3·65	9·74
Whangamomona	5·72	6	1·87	6·88
Eltham	7·10	12	2·70	5·10
Tairua	3·98	14	1·50	7·26
Tauranga	4·36	11	1·38	5·15
Maraehako Station, Opotiki	5·90	8	2·56	5·63
Gisborne	2·21	15	0·89	5·42
Taupo	2·91	8	0·76	3·98
Napier	2·60	13	1·25	3·71
Hastings	2·49	10	1·59	3·33
Taihape	2·34	13	0·62	3·50
Masterton	3·64	16	1·15	4·02
Patea	3·15	10	1·03	4·19
Wanganui	2·57	12	0·51	3·36
Foxton	2·45	5	1·18	3·23
Wellington	7·79	14	1·73	3·98
South Island.				
Westport	6·59	16	1·34	8·35
Greymouth	4·64	11	1·03	8·08
Hokitika	4·37	11	1·12	9·71
Ross	5·03	9	1·28	10·05
Arthur's Pass	8·89	10	4·10	13·04
Okuru	3·56	5	1·64	11·09
Collingwood	6·89	9	2·88	8·99
Nelson	5·12	9	2·02	3·06
Spring Creek	4·77	6	1·35	2·95
Hanmer Springs	7·31	14	1·91	4·39
Highfield, Waiau	5·70	9	2·50	3·19
Gore Bay	4·98	10	1·51	3·31
Christchurch	1·29	12	0·76	2·53
Timaru	3·37	6	2·50	1·41
Lambrook Station, Fairlie	..	..	..	1·50
Benmore Station, Clearburn	1·03	9	0·42	1·81
Oamaru	2·33	5	0·84	1·59
Queenstown	1·30	10	0·38	2·57
Clyde	0·56	5	0·24	1·00
Dunedin	2·21	10	0·45	3·11
Wendon	1·49	8	0·34	2·02
Gore	1·84	16	0·30	2·56
Invercargill	3·41	21	0·48	4·34
Puysegur Point	5·37	24	0·75	6·74
Half-moon Bay	6·52	23	1·36	4·75

CERTIFICATION OF SEED POTATOES.

PROVISIONAL CERTIFICATES ISSUED FOR SEASON 1931-32.

A LIST of growers who have received provisional certificates in connection with the system of Government certification of seed potatoes in the past season is printed below.

Provisional certificates are issued with the object of affording growers some indication of the general standard of their crops and assisting them in the disposal of their seed. Certification tags to be attached to the sacks are issued later, provided that an officer of the Department of Agriculture inspects the graded seed potatoes and is satisfied that they are still of the same standard of purity and freedom from disease as was indicated by the field inspection.

NOTE.—Lines entered under the name of the Government Pure Seed Station comprise relatively small areas of "selected" seed. Applications for this seed should be made to the Government Pure Seed Station, P.O. Box 4, Lincoln.

LIST OF GROWERS.

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Aucklander Short-top :—			
Stafford, J., Springston	10·1	..	1
Oakley, W., R.M.D., Halkett	10·0	..	4
Crump, F., Springston	9·8	..	4
Government Pure Seed Station, Box 4, Lincoln ..	9·7	..	..
Jellie, J., Russley Road, Fendalton (line A)	9·7	..	2
McPhail, W. A., Mitcham, via Rakaia	9·7	..	3
Poulton, A. D., R.M.D., West Eyreton (line A) ..	9·7	1·0	4
Rich, A. J., R.M.D., Kaiapoi	9·7	..	20
Nairn, G., Lakeside	9·6	1·8	2
Roper, R. S., R.M.D., Halkett	9·6	0·5	3
Allison, J., R.M.D., Courtenay	9·5	..	2
Seyb, L., Washdyke, Timaru	9·5	..	1
Marshall, D., R.M.D., Leeston	9·4	1·5	10
Poulton, A. D., R.M.D., West Eyreton (line B) ..	9·4	..	2
Redmond, C., R.M.D., Kimberley	9·4	0·1	14
Eder, W., R.M.D., Sefton	9·3	..	14
Marshall, H. M., R.M.D., Weedon's	9·3	..	1
Martin, W. E., R.M.D., Kaiapoi	9·3	0·4	18
Pirie, J., Kingsdown, Timaru	9·3	..	1
Quigley, W., Doyleston	9·2	0·2	3
Swanston, W., Selwyn	9·2	0·8	4
Dyer, H., Southbrook, Rangiora	9·1	..	2
Guy, T. A., Yaldhurst, Christchurch	9·1	..	2
Roper, P. F., R.M.D., Halkett	9·1	..	1
King, W. H., Rosewill, Timaru	9·0	0·3	4
Petrie, J., jun., Swannanoa (line B)	9·0	..	5
Robinson, R. G., Papanui	9·0	..	1
Smith, E. A., R.M.D., Lincoln	9·0	1·0	20
Moore, H. S., Box 4, Kaiapoi (line A)	8·9	0·3	2
Wolff, R. G., R.M.D., Horrelville	8·9	..	5
Pretsch, F. J., 257 Wairarapa Road, Bryndwr ..	8·8	1·0	2
Rangiora High School, Rangiora (line A)	8·8	0·8	1
Burgess, D., West Plains, Southland	8·7	0·3	1
Needham, M. R., North Road, Kaiapoi (line B) ..	8·7	0·4	1
Rathgen, A. E., R.M.D., Leeston	8·7	1·2	3

LIST OF GROWERS—*continued.*

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Aucklander Short-top—continued.			
Canterbury Agricultural College, Lincoln	8·6	1·7	2
Cross, H. E., Sandy Knolls	8·6	..	3
Haines, C., 108 Waimak Road, Harewood	8·6	..	2
Moore, H. S., Box 4, Kaiapoi (line B)	8·6	..	3
Heron, F., R.M.D., Rangiora	8·5	1·0	72
Relling, H., Tycho R.D., Timaru	8·5	..	3
Cross, S., R.M.D., Weedon's	8·3	..	2
McMullan, J. D., North Road, Kaiapoi (line A)	8·3	..	20
Warren, J., 149 Russley Road, Fendalton (line A)	8·3	1·0	25
Petrie, J., jun., Swannanoa (line C)	8·2	1·3	4
Barnett, R., Dunsandel	8·1	0·2	9
Gudex, G., Levels, Timaru	8·0	..	2
Warren, J., 149 Russley Road, Fendalton (line B)	8·0	1·0	5
Bishop, R. G., R.M.D., Southbridge	7·8	..	2
Carroll, A. D., R.M.D., Southbridge	7·8	0·6	8
Jellie, J., Russley Road, Fendalton (line B)	7·8	..	1
Mulcock, F. J., Ryan's Road, Christchurch	7·8	..	5
Needham, M. R., North Road, Kaiapoi (line A)	7·8	..	4
Petrie, J., jun., Swannanoa (line A)	7·8	1·6	2
Shea, F., Makikiki	7·8	..	3
Sloan, Mrs. M., Lakeside	7·8	1·0	6
Weeber, H., Enfield Road, Belfast	7·8	..	5

Cropping-powers (in tons per acre) of lines which have been rejected or withdrawn: 10·2, 9·7, 9·6, 9·5, 9·3, 9·1, 8·5, 8·3, 8·2, 7·9, 7·9, 7·8, 7·7, 7·7, 7·7, 7·6, 7·6, 7·5, 7·5, 7·5, 7·3, 7·3, 7·2, 7·2, 7·1, 7·0, 6·9, 6·8, 6·8, 6·7, 6·7, 6·6, 6·4, 6·3, 6·2, 6·1, 5·7, 5·6, 5·3, 5·1, 3·7.

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Dakota:—			
Marshall, D., R.M.D., Leeston	10·1	..	5
Eder, W., R.M.D., Sefton	9·9	..	19
Gardiner, O. J., R.M.D., Dunsandel	9·8	..	6
Cross, H. E., Sandy Knolls (line A)	9·7	..	2
Chambers, A. J., West Melton	9·2	..	3
McPhail, W. A., Mitcham, via Rakaia	9·2	..	6
Cross, H. E., Sandy Knolls (line B)	9·1	..	5
Barnett, R., Dunsandel	9·0	..	6
Cross, S., R.M.D., Rolleston	8·9	..	6
Wolff, R. G., R.M.D., Horrelville	8·9	..	1
Allison, J., Weedon's	8·8	..	1
Dulieu, H. P., Greenpark, Tai Tapu	8·8	..	2
Tweedy, S., R.M.D., Dunsandel	8·8	..	5
Shellock, W., Mead Settlement, Rakaia	8·7	..	1
Walker, C. E., R.M.D., West Melton	8·7	..	5
Anderson, S. H., Lyndhurst, Methven	8·6	..	1
Burrowes, J., Mitcham, via Rakaia	8·6	..	10
Dolan, M., Leeston	8·5	..	2
Frazer, R. W., Southbrook, Rangiora	8·5	0·1	4
Jones, C. H., R.M.D., Methven	8·5	..	5
McGregor, M., Windermere, Ashburton	8·4	..	5
Petrie, J., jun., Swannanoa	8·4	..	2
Rolston, G., R.M.D., Weedon's	8·3	..	3
Gardiner, C., Mitcham, Rakaia	8·2	..	1
Adams, D., Highbank, Methven	8·0	0·7	2
Hinton Bros., Templeton	8·0	..	13
McNae, F., R.M.D., Courtenay	8·0	..	15
Murphy, H. E., R.M.D., Weedon's	7·9	..	4
Upston, E. E., Selwyn	7·9	..	5

Cropping-powers (in tons per acre) of lines which have been rejected or withdrawn: 9·8, 9·3, 8·7, 7·8, 7·8, 7·7, 7·7, 7·6, 7·6, 7·6, 7·4, 7·3, 7·3, 7·2, 7·1, 7·0, 6·9, 6·9, 6·7, 6·6, 6·5, 6·5, 6·5, 6·4, 6·0, 5·9, 5·0, 4·3.

LIST OF GROWERS—*continued.*

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Aucklander Tall-top :—			
Cross, H. E., Sandy Knolls (line B)	10·5	..	3
Government Pure Seed Station, Box 4, Lincoln ..	10·0	..	..
Frost, C. H., P.O., Balcairn	9·9	..	5
Bailey, J., R.M.D., Kaiapoi	9·5	..	7
Brown, H. M., 114 Withell's Road, Riccarton, Christchurch	9·5	..	12
Simmons, W., Kingsdown, Timaru	9·1	..	3
Doak, J. H., Barrhill, Rakaia	9·0	..	2
Dulieu, H. P., Tai Tapu	9·0	..	2
Cross, H. E., Sandy Knolls (line A)	8·9	..	2
Warren, J., 149 Russley Road, Fendalton	8·9	1·0	6
N.Z. Loan and Mercantile Agency Co., Cashel Street, Christchurch	8·8	..	5
Steele, J., R.M.D., Darfield	8·8	1·2	2
Doak, A., Rangiora	8·7	..	2
Heckler, J. L., Mauriceville, via Masterton	8·7	0·3	2
Crowe, E., Waimate	8·6	..	5
Hewson, R. H., Seadown, Timaru	8·6	..	2
Guy Bros., Springbank, R.M.D., Rangiora (line A) ..	8·5	..	5
Frazer Bros., Southbrook, Rangiora..	8·4	..	6
Aicken, W. R., Dyerville, Martinborough	8·3	..	1
Hills, W., Oxford Road, Rangiora	8·3	..	3
Ryan, P. F., R.M.D., Springston	8·3	..	6
Steele, D., R.M.D., Ohoka	8·3	..	5
Watkins, E. R., Springbank, Rangiora	8·3	..	6

Cropping-powers of lines rejected or withdrawn: 9·0, 8·9, 8·2, 8·2, 8·1, 8·0, 8·0, 7·9, 7·7, 7·6, 7·6, 6·4, 5·9, 5·6, 4·5, 3·2.

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Up-to-Date :—			
Government Pure Seed Station, Box 4, Lincoln ..	10·5	..	..
Norman, H. D., Tuatapere	9·6	0·9	2
Kokay, S., Tuatapere	9·4	..	6
Robinson, R. G., Papanui	9·3	..	1
Butcher, D. and M., R.M.D., Broadfields	9·2	..	1
Manson, D. J., Enfield, Oamaru	9·2	..	1
Walker, C. E., R.M.D., West Melton	9·1	..	5
Gray, J. L., St. Andrews	9·0	..	2
Stewart, A., Marsh's Road, Templeton	9·0	..	1
Smyth, H., care of G. Manson, R.M.D., Darfield ..	9·0	..	1
Tutton, F. A., R.M.D., Broadfields	9·0	..	2

Cropping-powers of lines rejected or withdrawn: 9·0, 9·0, 9·0, 8·8, 8·0, 7·9.

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Arran Chief :—			
Knowler, H., Te Waewae	10·1	0·3	2
Saunders, E. E., Studholme Junction	9·6	..	2
King, R. M., Tuatapere (line A)	9·3	1·2	1
Teschner, C. A., Chatton Road, Gore	9·3	0·4	1
Knowler, C. E., Happy Valley, Tuatapere	9·1	0·6	1
Townshend, R. C., R.M D., Darfield	8·0	..	2
Frazer Bros., Southbrook, Rangiora	7·9	0·5	3
Watkins, E. R., Springbank, Rangiora	7·9	..	1
Grant, A., Waimate	7·6	1·0	3
Bell, J. F., Stirling	7·5	0·5	5
Dulieu, H. P., Tai Tapu	7·3	..	2
Anderson, A., Stirling	7·2	0·4	1
Kirkpatrick, W. T., Airedale R.D., Oamaru	7·2	0·8	2

Cropping-powers of lines rejected or withdrawn: 9·0, 7·3, 7·1, 7·1, 7·1, 7·0, 6·7, 6·2, 6·1, 6·0, 5·3, 3·7.

LIST OF GROWERS—*continued.*

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage
King Edward :—			
Milburn, M., Wright's Bush, Invercargill	8·2	0·2	1
Teschner, C. A., Chatton Road, Gore	8·1	..	1
Kokay, S., Tuatapere	8·0	..	2
Burgess, D., West Plains, Southland	7·4	0·4	2
Brown, W. E., Orepuki	7·2	0·4	2
King, W. S., The Bend, Winton	7·1	0·3	1
Caulfield, J. T., Rakahauka R D., Glencoe, Invercargill ..	7·0	..	1
King, L. A., Rakahauka R.D., Glencoe, Invercargill ..	6·9	0·1	3
Anderson, A., Stirling	6·8	0·3	4
Knowler, C. E., Happy Valley, Tuatapere	6·6	0·1	2
Knowler, H., Te Waewae, Southland	6·6	1·0	2

Cropping-powers of lines rejected or withdrawn: 6.5, 6.3, 6·2, 5·8, 5·6, 5·4.

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage
Epicure :—			
Carroll, J., Southbridge	6·3*	..	1
Barnett, R., Dunsandel	6·2*	..	3
Tweedy, S., R.M.D., Dunsandel	6·1*	..	1
Carroll, A. D., R.M.D., Southbridge..	6·0*	..	1
Moriarty, L., Southbridge	6·0*	..	1
McLachlan, G., R.M.D., Southbridge	5·3*	..	20
Robinson, R. G., Papanui	5·2*	..	2
Shellock, W., Mead Settlement, Rakaia	5·2	..	2

Cropping-powers of lines rejected or withdrawn: 5·1,* 4·8, 4·5,* 4·2, 3·5, 3·2, 3·2, 3·1.

* These lines are taller-growing and rather later-maturing than the usual Epicure, but not a typical "bolter" type.

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage
Bresee's Prolific :—			
Marshall, D., R.M.D., Leeston	8·2	0·8	20
Ford, S., Templeton	7·4	0·7	2
Butcher, D. and M., R.M.D., Broadfields	7·1	..	3
Guy, T. A., Yaldhurst, Christchurch	6·8	0·5	6

Cropping-powers of lines rejected or withdrawn: 6·2, 6·0, 5·8, 5·7, 5·6.

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage
Iron Duke :—			
Government Pure Seed Station, Box 4, Lincoln ..	8·6	..	..
Buchanan, A. R., Kairanga, Palmerston North ..	7·7	..	3
Spillane, A., Temuka	7·4	0·3	1
Seyb, L., Washdyke, Timaru	7·2	1·5	1
Robinson, R. G., Box 4, Papanui	6·8	..	2

Cropping-powers of lines rejected or withdrawn: 6·8, 6·8, 5·8, 5·6.

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage
Majestic :—			
Government Pure Seed Station, Box 4, Lincoln ..	8·8	..	..
Robinson, R. G., Box 4, Papanui (line A)	7·9	..	1
Robinson, R. G., Box 4, Papanui (line B)	7·7	..	1

Cropping-powers of lines rejected or withdrawn: 7·5, 6·5, 6·4.

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage
Early Rose :—			
Burns, R. A. C., Mead Settlement, Rakaia	8·0	..	4
Weaver, J., R.M.D., Te Pirita	7·9	..	3
Poulton, A. D., R.M.D., West Eyreton	6·8	1·3	1

Cropping-powers of lines rejected or withdrawn: 5·6, 5·3, 4·3.

LIST OF GROWERS—*continued.*

Name and Address.	Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Robin Adair :—			
Marshall, D., R.M.D., Leeston	7·6	..	3
Robinson, R. G., Box 4, Papanui	7·2	..	1
Brown, A. F., 92 Woolridge Road, Harewood ..	6·8	..	1
Cropping-power of line rejected: 5·5.			
Field Marshal :—			
Wright, L. T., Annat	9·0	..	13
Gray, J. L., St. Andrews	8·9	..	2
Robinson, R. G., Box 4, Papanui	8·9	..	2
Cropping-power of line rejected: 7·8.			
Great Scot :—			
Government Pure Seed Station, Box 4, Lincoln ..	9·0	..	..
Robinson, R. G., Papanui	7·4	1·0	1
Cropping-power of line rejected: 7·1.			
Arran Victory :—			
Smyth, H., care of G. Manson, R.M.D., Darfield ..	9·0	..	1
Cropping-power of line rejected: 6·2.			
Early Regent Bolter :—			
Oakley, W., R.M.D., Halkett	10·5	..	4
Cropping-power of line rejected: 8·0.			
Ally :—			
Government Pure Seed Station, Box 4, Lincoln ..	4·2	..	..
Cropping-power of line rejected: 3·2.			
Arran Banner :—			
Government Pure Seed Station, Box 4, Lincoln ..	8·5	..	..
McNae, F., R.M.D., Courtenay	8·5	..	3
Endurance :—			
Burns, R. A. C., Mead Settlement, Rakaia	10·9	..	1
Cropping-power of line withdrawn: 9·6.			
Abundance :—			
Government Pure Seed Station, Box 4, Lincoln ..	9·0	..	..
Kerr's Pink :—			
Government Pure Seed Station, Box 4, Lincoln ..	8·2	..	..
Arran Consul :—			
Government Pure Seed Station, Box 4, Lincoln ..	8·0	..	..
British Queen :—			
Government Pure Seed Station, Box 4, Lincoln ..	5·2	..	..
Sharpe's Express :—			
Government Pure Seed Station, Box 4, Lincoln ..	4·4	..	..
Jersey Bennes :—			
Government Pure Seed Station, Box 4, Lincoln ..	4·3	..	..
May Queen :—			
Government Pure Seed Station, Box 4, Lincoln ..	4·3	..	..
Di Vernon :—			
Government Pure Seed Station, Box 4, Lincoln ..	4·2	..	..

LIST OF GROWERS—*continued.*

Name and Address.		Cropping-power in Tons per Acre.	Percentage of Foreign Varieties.	Acreage.
Witchhill :—				
Government Pure Seed Station, Box 4, Lincoln	..	4·0	..	..
Eclipse :—				
Government Pure Seed Station, Box 4, Lincoln	..	3·7	..	..
Northern Star :—				
Robinson, R. G., Papanui	..	7·4	..	2
Early Puritan :—				
Cropping-power of line withdrawn: 2·4.				

—*Fields Division.*

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.

FEEDING OF CONCENTRATES TO DAIRY COWS IN EARLY PART OF SEASON.

R. H. C., Inglewood :—

We contemplate the adoption of "hard feeding" in the coming season, and propose using a mixture of fifty-fifty bran and meat-meal, which would be fed to the cows during milking-time. This hard feeding would be in operation during the period from calving-time until the new grass comes away —say, from the last week in July until the middle of October—the objective being the maintenance of the milk production at the maximum, with avoidance of the temporary decline which otherwise occurs during the period in question. We should be obliged if you would indicate what in your opinion would be a suitable quantity of feed per cow of the above-mentioned mixture, and whether to obtain the best results it should be fed at one issue or both night and morning. Assuming that a quantity of bran and meat-meal is fed to the cows during milking-time, what should be the average ration of hay and ensilage under conditions where the "roughage" is very scanty.

The Live-stock Division :—

The feeding of concentrates to dairy stock during the early part of the milking season is a practice which may be extended with advantage. During this period there is a scarcity of grass, and a ration of hay and ensilage is not sufficiently rich in productive materials to maintain a high milk-yield. The ration may be supplemented with meat-meal and bran. Some difficulty may be found in getting cows to eat meat-meal at first. In this respect it is advisable to train the cows to feed from boxes, commencing with a ration of ¼ lb. meat-meal with 2 lb. of bran per head twice daily. When the cows become accustomed to the meat-meal it may be increased to ½ lb. per head twice daily, the bran ration remaining the same. It is therefore advisable to feed the ration in the proportion of one part of meat-meal to four parts of bran. A good quality of meat-meal should be used, free from fibre and containing the minerals in a finely ground state. Feed twice daily for preference. The above may be used as a basal ration for all cows. Strictly speaking, high-producing cows will receive more of the mixture than low-producing animals. The ration of ensilage and hay cannot definitely be stated in terms of pounds weight, as a good deal depends upon the breed of cattle, their general condition, and the amount of roughage available. As a

guide it may be stated that about 10 lb. of hay with 30 lb. of ensilage may be fed daily per head in the case of Jersey cows. For economy purposes, where the herd is not too large, it is advisable to feed this portion of the ration from movable racks.

DESTROYING STINGING NETTLES WITH SODIUM CHLORATE SPRAY.

"NETTLED," Upper Hutt :—

I should be glad if you could advise me as to the best means of getting rid of stinging nettle, which is spreading rapidly in my poultry-runs. It grows so rapidly in cultivated ground that it threatens to oust grass or any other desired plant.

The Fields Division :—

Stinging nettles are easily eradicated by spraying with a 5-per-cent. solution of sodium chlorate. This chemical is not poisonous to animals, and the vegetation in the fowl-runs can be sprayed without shifting the birds. Clothing which has been saturated with the mixture should be rinsed out in clean water immediately afterwards; otherwise, if allowed to dry, it is liable to fire, and for this reason no smoking should be allowed while handling the fluid.

KILLING MACROCARPA-TREES WITH POISON.

J. D. WATKINS, Kopaki :—

I noticed in the March *Journal* that it is possible to kill willow-tree with arsenic. Can you tell me if this can be done for macrocarpas too, and, if so, how much arsenic is needed, and is it put in dry or in solution? Is there anything better than arsenic for killing them? I have some macrocarpas which I want to kill, but not to cut at present, and if there is some way of poisoning them that will be easily the best thing to do.

The Horticulture Division :—

The macrocarpa cypress trees may be destroyed in the same way as the willows—that is, by boring the trunk with an auger in a sloping direction, filling the holes with any weed-killer, and plugging them afterwards to prevent evaporation. The arsenic weed-killer is made as follows: Thoroughly mix 1 lb. arsenic and ¼ lb. caustic soda in a tin, add water gradually and stir till the arsenic is dissolved, then make it up to 4 gallons. The mixture is very poisonous and should be carefully handled. The utensils should not be used for any other purpose.

VAGINITIS IN COWS.—MINERAL REQUIREMENTS OF PIGS.

H. B. IGGULDEN, Norsewood :—

Can you let me have (1) a reliable remedy or treatment for vaginitis, and (2) a recipe of a mineral mixture that I could mix and feed to pigs.

The Live-stock Division :—

(1) No importance is attached to the presence of small nodules or "granules" on the vaginal membrane, in so far as sterility is concerned. Where vaginitis of a pustular nature is present, with discharge, such cows should not be allowed near the bull, and the vaginal passage should be washed out daily for a week with a solution made by adding one ½ oz. of Lugol's solution of iodine to a quart of water.

(2) The mineral requirements of pigs are met by the use of meat-meal in the diet. Meat-meal being not only rich in protein but also in minerals. If desired, a meat-meal containing 20 per cent. of bone-meal can be used. The quantities fed will approximately be for weaner pigs about 4 oz. daily, increasing to 6 oz.; for pigs three months or older ½ lb. per day. Sows in pig can be given ½ lb. per day, and a few days after farrowing should receive 1 lb. daily until the piglets are weaned

New Zealand Department of Agriculture.

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CONTROL OF CASEOUS LYMPHADENITIS IN SHEEP.

C. V. DAYUS, M.R.C.V.S., District Superintendent, Live-stock Division, Dunedin, and C. S. M HOPKIRK, B V.Sc., Officer in Charge, Veterinary Laboratory, Wallaceville.

MANY of our sheep-farmers will be familiar with a condition met with in sheep—more commonly in Merinos and half-breds—known as caseous lymphadenitis, and characterized by lesions simulating abscess formation found in various lymphatic glands of the body. Lymphatic glands are round or oval bodies varying in size, interposed in the course of the lymphatic vessels, and through which the lymph passes in its course to be discharged into the blood-vessels.

In lambs and adult sheep the commonest lymphatic gland found affected with caseous lymphadenitis is the prescapular, situated at the base of the neck just above the point of the shoulder. The next commonest gland affected in adult sheep is the precrural, situated in the thin flank. In lambs the second commonest gland affected is the popliteal, situated in a pad of fat deep in the muscular tissue at the back of the leg between the hock and the stifle (this gland is generally seen and incised when carving a leg of lamb); the gland is also affected in adult sheep. Other lymphatic glands affected are the supramammary in the female, situated above the posterior margin of the base of the udder; the corresponding gland in the male, the superficial inguinal, is also affected. More rarely lesions are found in various internal lymphatic glands.

When affected with the disease the lymphatic gland becomes enlarged to a varying degree; the lesion in the gland consists of localized inflammation, followed by a suppuration with nodule formation, a capsule surrounding the nodules. The contents of this suppurating nodule consist of a greenish-coloured pus, which, when the condition has been in existence for some time, becomes converted into a cheesy looking material. The lesion is produced by infection with a specific bacterial organism, *Corynebacterium pseudotuberculosis* (Preisz Nocard bacillus), which was first described in France in 1891. This organism is relatively resistant to drying, and under certain conditions it may remain viable for many months, but it can easily be destroyed by disinfectants.

The common method of infection is definitely through the inoculation of wounds or abrasions of the skin, such as occur in the operations of shearing, castration, docking, crutching, &c. This view is supported by work carried out at the Wallaceville Veterinary Laboratory, where more or less typical lesions have been set up by the experimental inoculation of skin wounds, and by shearing sheep with shears upon which pus from ruptured abscesses had been smeared. Further work to ascertain other possible methods of infection have all ended in failure—namely, infection by means of the sheep ked, by drenching sheep with pus and cultures of the organism over prolonged periods, and by running lambs on affected sheep in the attempt to affect lambs.

Caseous lymphadenitis is known to occur in parts of Europe, the United States of America, Argentina, Australia, and New Zealand. The incidence of the disease in New Zealand is fortunately very much lower than in either the Argentine or Australia. The percentage found in all adult sheep slaughtered in this country is only 1·54, and in lambs slaughtered 0·096. The figure shown for the lambs may be considerably modified in that the majority of cases found with abscesses present as a result of castration have been shown to be affected with other organisms than the Preisz Nocard bacillus. Nevertheless, it is obvious that every effort should be made to prevent any possible increase, and also still further to reduce the present incidence.

The disease is of considerable economic importance because no mutton or lamb carcasses found affected may be exported from the Dominion; consequently in the meat-export slaughterhouses a good deal of time is expended by the inspection staff of the Live-stock Division in detecting affected carcasses.

In the circumstances mentioned, it is hardly necessary to emphasize the importance of methods of control being evolved that appear to be satisfactory and at the same time capable of efficient application in practice. The possibility of control measures has been engaging the attention of the Live-stock Division for some time past, and definite work has been in progress during the past two seasons on the methods to be described.

It has been realized that the main concentration of infective material is most likely to take place in the shearing-shed and its immediate neighbourhood, where sheep have congregated, often in very large numbers, probably for some years past. Quite a number of abscesses are opened during shearing, and the discharge contaminates the wool, which may also be similarly contaminated by the discharge from abscesses ruptured some time previously. It can readily be understood that in shearing such sheep the shears passing through the contaminated wool will carry away sufficient material to infect other parts of the same animal or the following sheep, and that a ruptured abscess on a sheep moving about among its shorn fellows in the yards may infect many cuts which escaped such infection with the shears.

This knowledge suggested the early detection of all affected sheep and their strict isolation, so that they can be crutched and shorn after the main operations have been completed. Thorough disinfection, in addition, is essential.

Detection of Affected Sheep by Palpation.

The lymphatic glands mentioned in the introduction can be palpated by hand and any enlargement detected; this is especially easy in sheep not carrying too much wool and condition. The best way to carry out such an examination efficiently on a large number of sheep, is to put them through the shearing-shed, up-end them, and examine each sheep carefully in the manner shown in the accompanying photographs, showing palpation of the prescapular, precrural, popliteal, and supra-mammary or superficial inguinal glands respectively. Naturally a certain amount of instruction and demonstration on live sheep and also carcasses will be necessary before farmers can become quite competent to undertake the examination for themselves. Afterwards a certain amount of work is involved, but there is no very great difficulty in the procedure.

Some convenient muster can be selected for the purpose of palpation; it may not be possible to do all sheep at shearing-time, owing to difficulty in holding the sheep in the vicinity of the shearing-shed any undue length of time at that period of the year. In the case to be illustrated the wethers were examined at the dipping muster, and the ewe flock at the autumn muster. A ewe flock was examined at the beginning of May, 1931 (by C.V.D.), with the following results:—

Table 1.

Number of Sheep examined.	Age.	Number found affected.	Percentage.
3,753 ..	Two-tooths	38	1·01
2,976 ..	Two years rising three ..	219	7·36
2,531 ..	Three years rising four ..	346	13·67
1,936 ..	Four years rising five ..	443	22·88
11,196 ..	..	1,046	9·34

The above table gives a good indication of the increased incidence of the disease with rising age. This is a generally acknowledged fact, due to more frequent exposure to infection at successive shearings, crutchings, &c. It will be noted that no figures are shown for lambs, as the whole of the lambs were not examined, owing to the known low incidence in unshorn lambs. However, 3,046 lambs were carefully examined after slaughter at the freezing-works in 1931, and 1,781 in 1932, without the detection of a single lesion.

The following precautions were taken after the 1931 examination: (1) The whole of the affected ewes, numbering 1,046, were specially branded and kept entirely separate from the main flock; (2) at shearing No. 2 combs were used on all sheep for the first time; by this method the number of cuts and abrasions was considerably reduced; (3) the affected ewes were crutched and shorn by themselves after the main operations; (4) the machine-heads were dismantled and carefully disinfected after crutching and shearing the affected flock; (5) during crutching and shearing special attention was paid to the dressing of cuts, though in machine-shorn sheep it is found that there are a number of very small wounds in which the skin is only just broken,

FIG 1. SHOWING METHOD OF PALPATION OF THE PRESCAPULAR GLANDS.

FIG 2. PALPATION OF THE PRECRURAL GLANDS.

FIG. 3. PALPATION OF THE POPLITEAL GLANDS.

FIG. 4. PALPATION OF THE SUPRA-MAMMARY OR THE SUPERFICIAL INGUINAL GLANDS, AS THE CASE MAY BE.

many of these not being noticed and escaping being dressed; (6) the shearing board was disinfected before and after shearing, and the ground of holding-yards, &c., was cleaned up and dressed with quicklime.

The main ewe flock was again examined at the beginning of May, 1932, with the following results:—

Table 2.

Number of Sheep examined		Age.		Number found affected.	Percentage.
2,121	..	Two-tooth	..	10	0·47
3,450	..	Two years rising three	..	81	2·34
2,810	..	Three years rising four	..	161	5·72
1,748	..	Four years rising five	..	125	7·15
10,129	..	..		377	3·72

The results of this examination were looked forward to with very great interest, as it was obvious that if the work was to be justified the incidence must show a marked decline in the first year. The total percentage of affected sheep has declined from 9·34 to 3·72, which is considered particularly satisfactory for the second examination only. In addition the lesions found in the affected sheep were generally smaller than those found in 1931, also there were fewer sheep with more than one gland affected. The affected sheep have been segregated, and the examination will be repeated again next year, after the usual precautions have been observed in the meantime. The figures for the wethers are not shown, as they were only examined for the first time in 1932.

Of the 1,046 sheep segregated in 1931 the 443 five-year-olds were disposed of, but 575 of the remainder were re-examined in 1932. Of these, 317 were still noticeably affected, five showed open lesions, and six showed recent scars; but in 258 no lesions were then noticeable.

Palpation in Drafting-yards.

As an alternative method to up-ending sheep, one of us (C.S.M.H.) tried the following means of palpation on 16,000 ewes on a station where caseous lymphadenitis was not particularly bad but sufficient in extent to inconvenience the owner:—

Sheep are run into classing-yards, 5 ft. by any convenient length, such being common in most well-designed sheep-yards. These yards open into the diamond, and thence through the drafting race. The classing-yards are filled two-thirds full, thus holding about forty sheep. Sheep should be run in just before palpating commences, otherwise they tend to turn round and make it much more difficult for those working. Two men side by side then commence from the back of the sheep feeling for enlarged glands, running their hands over the shoulder and gripping deeply beneath the muscle over the point of the shoulder, then passing on to the loose flank in front of the hind legs, and finally feeling the udder for any swelling. In older ewes the udder is a very common position for abscesses to be found in, and any hard lump deep in the tissue or discharging to the surface should cause

the sheep to be culled. A raddle mark can be used to draft the sheep out at the race. As one pen is finished the two operators climb over the dividing-fence between the two pens and commence on the second pen. Meanwhile the first pen is refilled by the shepherd in charge. A tally of the sheep run through is kept at the race. The number actually palpated per day depends largely on the following conditions :—

(1) The state of the sheep; for example, wet weather makes the sheep difficult to move and hard to handle, and in any case the work is most uncomfortable in wet yards and heavy coats. Dry sheep run well, and younger sheep run better but fight more than old ones. The length of wool is also a very great factor.

(2) The state of the hands of the workers and their bodily fitness is probably the greatest limiting factor in the work. Constant use of the fingers makes the hands swell, and after a number of hours the work is not nearly as exact as at the commencement of the day.

(3) The arrangements for bringing in sheep and getting rid of them following palpation also limit the numbers put through. Very few large sheep-owners could bring in the sheep for the one class of work only, and one therefore has to decide on a time suitable for the farmer for palpation. It is much simpler to do sheep without wool than in full wool; therefore directly after shearing would naturally be the easiest time. But there is so much to be done at shearing-time that this is not practicable in many instances; also there arises the question of whether it would not be directly detrimental to bring sheep into closer quarters than is necessary after shearing, when there are many ruptured abscesses to be seen, and many fresh cuts ready for infection when a sheep smeared with pus pushes along among its neighbours in a close yard. Weaning-time or classing-time then suggest themselves, and as sheep have then been shorn some two or three months and wool is not very long such times suggest themselves as being best from all points of view. In the autumn only the breeding-ewes are left on the place as a rule, except possibly a few wethers, and as these ewes are classed for putting to the rams as regards age, conformation, wool, condition, &c., it is easy to apply then the palpation method for caseous lymphadenitis.

The result of the palpation of the flock last referred to was as follows :—

Table 3.

Number of Ewes examined.	Total.	Number affected.	Percentage.
Four-tooth	3,657	16	0·44
Six-tooth	3,999	104	2·60
Four-years	5,770	250	4·33
Five-years	2,818	169	6·00
	16,244	539	3·32

It was considered unnecessary to put through the seven thousand two-tooths on this particular station. A further palpation will be carried out in the 1933 autumn to find whether this method can compare favourably with the up-ending method. The affected sheep, 539 in number, have been segregated and mated with rams as a separate flock.

Some other Observations.

At Wallaceville eight ewes with abscesses easily palpable were kept two years and examined each fortnight. Two of the ewes had enlarged glands which failed to rupture ; one was lanced and developed large numbers of internal abscesses, probably as a result of the surgical interference ; the remaining five when killed appeared perfectly clean, and the once affected glands were practically normal. The question therefore arises as to the absolute necessity for getting rid of sheep which may later become normal. It is necessary to segregate while such ewes clean up, but if when abscesses have ruptured and cleaned up, the ewes are repalpated on two occasions at several month interval and found normal, then it would seem permissible to return such animals to the flock. However, most flock-owners would not care to take the risk entailed and would sooner slowly cull those sheep once found affected.

It is a noticeable fact that the left side glands are more commonly affected than the right, and this may possibly be explained by the fact that the shearer opens up the fleece from the left side, more or less on the blind as it were, and consequently makes more cuts and abrasions and any pus on the machine-head is left in the cuts. He is working the machine-head towards the body of the sheep instead of away from it, as is the case on the right side. The persistency of this fact is shown by the following data in connection with flocks examined :—

Table 4.

Examinations.	Number of Affected Glands.					
	Prescapular.		Precrural.		Popliteal.	
	Right.	Left	Right.	Left.	Right.	Left.
Ewe flock, 1931 ..	171	198	224	261	1	4
Wether flock, 1932 ..	48	77	56	77	9	14
Ewe flock, 1932 ..	65	80	55	93	1	4
Totals ..	284	355	335	431	11	22

Besides palpation and segregation of the sheep annually, disinfection of shearing-machine combs or of blades is necessary for the first year or two at least. It is still a matter of trial as to which is the best disinfectant to use for the purpose, but it is hoped to be able shortly to incorporate a disinfectant into the oil used for lubricating the machine. The majority of watery solutions cannot penetrate the oil and lanolin covering the machines, so that a special method will have to be employed.

Control Methods summarized.

Methods of control for caseous lymphadenitis in sheep have been indicated which are capable of practical application by all those owners of sheep concerned with the disease. Requirements are as follows :—

(1) Annual palpation of all sheep, two-tooth and upwards, with subsequent strict segregation of affected sheep.

(2) Affected sheep must not be exposed for sale except to meat-works.

(3) The affected sheep to be shorn and crutched separately, preferably at the conclusion of the main operations.

(4) If shearing is done by machines, No. 2 combs or thicker ought to be used. Blade shearing is very satisfactory, as it has previously been noted that the incidence of the disease is greater in machine-shorn flocks than in blade-shorn. More cuts and abrasions are made with machines than with blades.

(5) Where practicable sheep could be passed through a so-called "non-poisonous" dip off the shears.

(6) Thorough disinfection of blade shears and machine-heads after the shearing and crutching of the affected flock and before the commencement of the respective main operation is absolutely essential, also during shearing and crutching, especially when an abscess is met with. A systematic disinfection of the shearing-shed must be undertaken, and suitable treatment applied to the holding-yards, races, &c.

If the methods here advocated are systematically and thoroughly carried out each year, there appears no reason why caseous lymphadenitis in New Zealand should not be still further decreased, if not ultimately completely eradicated.

SOME ECONOMIC PHASES OF APPLE PRODUCTION IN NEW ZEALAND.

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AT present apple production in New Zealand is rapidly expanding; hence a survey of its activities is fully warranted to enable one to see how the industry is developing, what difficulties are likely to be met, and how they can be overcome. It is anticipated that production will increase by 17 per cent. within the next five years, indicating that the already acute marketing problems will become even more difficult in the future. This study, embracing the whole of the Dominion, presents a picture which may be of value to producers. The results presented are based on the production season of 1930–31, and are a fuller continuation of the investigation instituted the previous year, 1929–30.

Of the 1,370 questionnaires posted, 870 were returned, of which 719 were used, while the balance of 151 had to be deleted because of incompletion or unsuitable data. The reliance that may be placed in the results is evident when one considers that of the total orchards having over 300 apple-trees producing fruit for sale, half are included in this study, while the number of trees represented is 44·4 per cent. of all apple-trees of orchards producing for sale.

Over 130 varieties were listed on the questionnaires returned. As a number of varieties have more than one name, it has been necessary to introduce uniformity in this respect. The names adopted, together with the alternatives in parentheses, are as follows: Cleopatra (New York Pippin), Desert Gold (Golden Delicious), Dunn's (Munroe's, Ohinemuri), London Pippin (Five Crown Pippin).

The data have been grouped into the following districts: North Auckland, Waitemata, Thames, Waikato, Gisborne, Hawke's Bay, Wairarapa, Manawatu, Nelson, Mapua-Tasman, Motueka, Marlborough, Christchurch, Southern Coastal, Tuapeka, Vincent. These names, with the exception of two, are self explanatory. The boundary between Rodney and Waitemata Counties is the boundary between North Auckland and Waitemata. Southern Coastal stretches from the northern boundary of Ashburton County to the southern boundary of Waitaki County, showing it to be a very extensive district. The districts chosen are apple-growing centres, and as such represent units in which the conditions operating between orchards are as constant as it is possible to make them in an analysis of this nature.

TOTAL PRODUCTION.

The contribution of individual districts to total production is a matter of some importance, particularly when considered in conjunction with the quantity exported from each. Table 1 is based on the total number of apple-trees in orchards producing fruit for sale as ascertained at 21st June, 1930, which, with the quantities exported, has been obtained from the Horticulture Division of the Department.

Table 1.—Estimated Total Production of Orchards producing Fruit for Sale and Total Export in 1930–31.

District.	Estimated Total Production.	Export.	Percentage exported.
	Bushels.	Bushels.	
North Auckland	128,000	38,100	30
Waitemata	399,000	73,700	18
Thames	23,000	..	..
Waikato	24,000	3,800	16
Gisborne	84,000	17,300	21
Hawke's Bay	584,000	188,600	32
Wairarapa	72,000	17,200	24
Manawatu	18,000	400	2
Nelson	300,000	200,100	67
Mapua-Tasman	448,000	303,600	68
Motueka	434,000	285,400	66
Marlborough	90,000	57,700	64
Christchurch	277,000	28,000	10
Southern Coastal	43,000	600	1
Tuapeka	183,000	70,600	39
Vincent	52,000	7,800	15
Dominion	3,159,000	1,292,900	41

The results shown in this table will be of great value in forecasting, as it will be possible to gauge not only the relative changes in production, but also the actual quantity a crop is expected to alter by, thus assisting growers to allocate quantities for shipment overseas in accordance with anticipated local requirements.

It will be shown later that there is considerable variation in tree yields between seasons. For example, in Waitemata the average production per tree for 1930–31 increased 30 per cent. over the previous year, while in Hawke's Bay it fell by 18 per cent. This must affect the local production of a district, and hence, while the results shown in

this table represent the position as it appeared in 1930–31 and give a rough idea of the present relative position of each district, the normal total production will probably differ from the results shown. Nevertheless, this seasonal fluctuation will not affect the value for forecasting; on the contrary, it is essential to know the variation.

Future Production.

It has been possible to predict what the approximate movement in production will be in the course of the next five years. This has been possible through being able to calculate the proportion each age-group yields and by knowing the proportions of trees in the different age-groups. Thus, all predictions, being based on proportions, refer to normal yields, and take the normal yield of 1930–31 as the base.

Three reservations are necessary. Since these predictions refer only to normal yields, they cannot take into account seasonal fluctuations. Secondly, no consideration has been given to replacement. The replacement ratio in apple-trees is, precisely speaking, an unknown quantity, but whatever it is it must be small, for if the commercial life be from twenty-five to thirty-five years, then this ratio varies from 4·0 per cent. to 2·9 per cent. But as the majority of trees have not far passed, if reached, the level of maximum production, any trees cut out bear a very small percentage to the total. Lastly, any change in efficiency of management must necessarily result in a change in production, and as management conditions are more likely to improve than to retrogress these predictions are likely to be conservative.

The position with regard to future production is shown in Tables 2 and 3. The former shows individual districts, as it is estimated they will increase by 1935–36 compared to 1930–31. As it indicates the degree to which a district is anticipated to expand, it forms a valuable guide indicating to what extent it is necessary to provide for future

Table 2.—Anticipated Normal Increase in District Production in 1935–36 over 1930–31, and District Contribution to Total Increase in New Zealand.

District.	Estimated Increase within District.	Contribution to Dominion Total Increase.	
	Per Cent.	Per Cent.	
North Auckland	17	4	
Waitemata	31	18	
Thames	29	1	
Waikato	57	3	
Gisborne	43	4	
Hawke's Bay	29	31	
Wairarapa	9	2	
Manawatu	15	1	
Nelson	10	5	
Mapua-Tasman	8	6	18
Motueka	11	7	
Marlborough	5	1	
Christchurch	11	6	
Southern Coastal	15	2	
Tuapeka	12	6	
Vincent	11	3	
Dominion increase	17	100	

Table 3.—Anticipated Normal Production for Years 1931–32 to 1935–36 expressed as a Percentage of 1930–31.

Year.	North Island.	South Island.	Total.
1930–31	100·0	100·0	100·0
1931–32	105·4	102·6	103·7
1932–33	110·9	105·1	107·4
1933–34	116·7	106·7	110·7
1934–35	122·5	108·6	114·1
1935–36	127·6	110·0	117·0

needs. The districts showing greatest proportional movement are Waikato and Gisborne, but the greatest movement in quantity is shown to be Nelson (including Motueka and Mapua-Tasman), Waitemata, and Hawke's Bay.

Table 3 affords an indication of what the relative movement in production will be in both Islands and in New Zealand as a whole up to 1935–36. In the North Island there will be an average annual increase of 5·5 per cent., aggregating to a total of 27·6 per cent. ; the same for the South Island is 2·0 per cent. and 10·0 per cent. ; while the New Zealand figure is 3·4 per cent. and 17·0 per cent. Further discussion on this phase is reserved till later.

Factors affecting Export.

There are two broad factors tending to determine the proportions of fruit exported from individual districts. They are size of district from the point of view of production, and proximity to local markets. These factors are interwoven one with another, one being of more importance in one district than in another. It must be noted that both factors operate in all districts, but the degree to which they operate varies considerably. They must not be interpreted literally, but attention must be given to what lies beneath.

Table 4.—Districts arranged in Descending Order of Proportions exported, with Total Production of 1930–31 as an Indication of Size.

District.	Proportion exported.	Total Production : Size of District.
	Per Cent.	Bushels.
Nelson	67	1,182,000
Marlborough	64	90,000*
Tuapeka	39	183,000
Hawke's Bay	32	584,000*
North Auckland	30	128,000
Wairarapa	24	72,000*
Gisborne	21	84,000
Waitemata	18	399,000*
Waikato	16	24,000*
Vincent	15	52,000
Christchurch	10	277,000*
Manawatu	2	18,000*
Southern Coastal	1	43,000
Thames	..	23,000

* Apparently anomalous.

In Table 4 all districts are arranged in descending order of proportions of total production exported, together with the size of district. There is a general tendency for the size of the district to decrease as the proportion of the export decreases. In seven out of the fourteen districts size of district falls without any anomaly. These are shown in Table 5.

Table 5.—Districts affected mainly by Size.

District.	Proportion exported.	Total Production : Size of District.
	Per Cent.	Bushels
Nelson	67	1,182,000
Tuapeka	39	183,000
North Auckland	30	128,000
Gisborne	21	84,000
Vincent	15	52,000
Southern Coastal	1	43,000
Thames*	..	23,000

* Position doubtful.

Closely associated with size is the extent to which orchards are scattered throughout a district. This effect—intensity—has been disregarded, not because of its lack of importance but because of the difficulty of measuring it, and because the causes which are significant in its importance are in the sum total the same as those which contribute to the importance of the size of district—namely, efficiency of organization. Their significance is due not so much to the fuller development of an exporting spirit as to the greater ease and economy with which it is possible to organize in the more intense and/or large districts. The economy of large-scale operation is too well known to need elaboration here, and that it has played a vigorous part in the proportions exported from districts of varying size and intensity is forcibly shown, and will be shown to have effect on the other factors. One must remember, however, that the smaller districts have to contribute a higher proportion to local demands.

The districts which appear to be anomalous can be more or less explained; they are indicated in the third column of Table 4 by asterisks. In Marlborough, Wairarapa, and Waikato it would appear that numerous factors of more or less equal importance are operating. Marlborough and Wairarapa appear to be influenced by the proximity of Wellington as an exporting port. Waikato, exporting 16 per cent., compared with Thames, exporting none, appears to be influenced by the proximity of Auckland as an exporting port. The small local demand for Marlborough, the intensity factor in the Waikato, and

Table 6.—Districts affected by Miscellaneous Factors favouring Export.

District.	Proportion exported.	Total Production : Size of District.
	Per Cent.	Bushels.
Marlborough	64	90,000
Wairarapa	24	72,000
Waikato	16	24,000

Wellington's plentiful supply from Hawke's Bay and Nelson, suggesting a restricted demand for Wairarapa, are also factors affecting the position. Table 6 shows these districts and illustrates how size again becomes important. These are all small districts, and hence the desirable advantages secured in a large-sized district cannot operate here.

Proximity to extensive local markets operates powerfully against size of district. This is clearly noticed in Waitemata, where the proximity of Auckland undoubtedly has an influence, diverting what would be export to local requirement. The ease with which growers can associate with local middlemen, coupled with local demands, has an influence of far-reaching importance. Hawke's Bay and Christchurch, too, have the same factor operating, but in Tuapeka it would appear as though Dunedin's needs are more easily satisfied.

The following table shows these districts, and again illustrates how size becomes significant.

Table 7.—Districts affected by Proximity of Local Market.

District.	Proportion exported.	Total Production : Size of District.
	Per Cent.	Bushels.
Hawke's Bay	32	584,000
Auckland	18	399,000
Christchurch	10	277,000
Manawatu	2	18,000

It is difficult to assign any predominating factor to Thames. It is quite possible that the small size of the district, together with its extensive character, coupled with the distance from Auckland, have been deterrents on export.

Marketing of the Increase.

The significance of the increased production is evidenced in the following calculation. The crop for the year 1930–31 has been taken as an average crop, and district reports over the whole Dominion indicate that this is so.

		Bushels.
1930–31	Production	3,159,000
	Export	1,293,000
	Balance for local consumption	1,866,000

	Bushels.
Production, 1935–36 (117 per cent. of 1930–31)	3,696,000
Production, 1930–31	3,159,000
Surplus, 1935–36 over 1930–31	537,000

Surplus as percentage of export 1930–31, 42 per cent.
Surplus as percentage of local consumption 1930–31, 29 per cent.

This means that the export facilities will have to bear an increase of 42 per cent. within the next five years if the surplus is to be entirely exported, while if none of the increase is exported the local market will have to absorb nearly one-third more than it did in 1930–31.

No emphasis is needed to stress the necessity for the organization of marketing both local and overseas. Because it is imperative to maintain and improve our prestige overseas by the best quality product, and because our increasing production necessitates export of the surplus, if New Zealand quantitative consumption remains constant, the quality of fruit remaining under existing conditions must tend to lower in quality. How can this lower quality be raised? A promising commencement has been made with the Dominion Mark scheme. That much fruit of exportable quality goes into local consumption can be deduced from a comparison of district proportions exported—Nelson as a whole exports 67 per cent., Hawke's Bay 32 per cent. It is a reasonable assumption, therefore, that the majority of the difference, 35 per cent., is of export standard but is absorbed by local demand. It is for this type of fruit that the Dominion Mark operates. But as time goes on this grade will probably be exported to prevent it exceeding the local demand, and thus fruit of a lower average quality must be marketed locally. Hence, if the quantity capable of finding a local sale as a graded product is not to be restricted, a grading scheme to cover this type appears imperative. An alternative is that the lower qualities be absorbed through factories for such commodities as dried apples, jam, or vinegar.

Continuing now to factors controlling export, it is clear that the productive size of the district is the most important. This, modified by local consumption, and in conjunction with proximity to exporting port and intensity, forms that very composite factor, efficiency of organization; but it is the quantity handled that determines the importance of the last. Hence, in the interests of the industry, maximization of export is a most desirable objective, as costs of export must then necessarily be reduced and innumerable advantages secured through large-scale operation, together with a smoother operation of the whole export machinery due to a greater degree of specialization in its many activities. One of the salient points here is the size of the orchard. The smaller the orchard the less is the tendency of the grower to export. Table 8, which shows the position in Waitemata, amply demonstrates this issue.

Table 8.—Effect of Size of Orchard on Distribution as shown in Waitemata District.

Range of Trees.	Number of Orchards.	Export.	Local.	Factory.	In Store.	Total.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Under 499	15	13·8	76·7	..	9·5	100·0
500–749	27	12·5	68·5	2·8	16·2	100·0
750–999	22	18·2	72·4	5·3	4·1	100·0
1,000–1,249	20	22·6	58·3	4·2	14·9	100·0
1,250 and over ..	24	28·2	53·4	7·8	10·0	100·0

The anticipated increase in production should result in a more than proportional increase in export. In so far as the present facilities are capable, districts will benefit in lowered cost, but in so far as they are not capable of handling the increase the difficulties of the producer will be aggravated until relieved by better organization. To conclude, therefore, if the total surplus is to be exported, facilities will be

needed to handle an increase of approximately 42 per cent. by 1935–36, while there is a probability of the quality falling internally. On the other hand, if the total surplus is not all exported a reduction in internal prices appears inevitable, unless factories can absorb much of the lower grades.

Comparative Annual Yields.

The principal function of Table 9 is to provide a basis of forecasting; its importance is to the industry as a whole, its merit being that it forms a basis which with the assistance of reliable estimates facilitates the prediction of a current season's crop.

Another phase of more importance to the individual orchardist is the use of the table as a gauge, indicating how his management is improving or retrogressing. To obtain this it is necessary to use the preceding year's yields—that is, it is based on two years' yields, the last year being expressed as a percentage of the first. This is open to the criticism that the age-constitution of trees is always changing

Table 9.—Average Yield per Tree in Bushels of all Trees of Bearing Age (Six Years old and over).

Variety.	North Auckland.	Waitemata.	Thames.	Waikato.	Gisborne.	Hawke's Bay.	Wairarapa.	Manawatu.
Sturmer ..	..	1·185*	..	2·099*	3·088*	3·753	1·615	0·802
Delicious ..	1·635	2·335	2·037*	1·466	5·415*	3·715	1·460	0·855
Jonathan ..	..	1·352	..	1·207*	..	2·759	0·837	..
Cox's Orange Pippin	..	1·269	..	..	..	2·959	1·684	..
Dunn's ..	1·302*	2·830	..	..	..	3·826	1·276	..
Statesman ..	1·438	..	..	..	..	3·395	..	..
Granny Smith	2·000*	2·854	..	..	..	..	..	..
Gravenstein ..	1·470*	1·330	..	0·340	..	3·149	..	..
Dougherty ..	1·882	1·527	..	..	..	3·931	..	..
Ballarat ..	..	2·825	..	..	7·346*	4·549	..	..
Other varieties	1·663	1·966	0·451*	1·636	..	4·622	3·251	1·008
All varieties	1·742	2·034	1·835	1·362	4·417	3·609	1·421	0·736

Variety.	Mapua-Tasman.	Motueka.	Nelson.	Marlborough.	Christchurch.	Southern Coastal.	Tuapeka.	Vincent.
Sturmer ..	2·101	2·434	2·365	2·148	1·736	1·537	1·718	0·607
Delicious ..	1·707	2·021	1·230	1·857	1·506	1·680	1·792	0·789
Jonathan ..	1·887	2·492	2·176	1·309	1·888	1·249	1·789	0·767
Cox's Orange Pippin	1·268	2·336	1·563	2·410*	0·805	..	0·751	0·882*
Dunn's ..	1·618	2·102	1·866	2·425*	2·117	..	0·950	1·618*
Statesman ..	2·413	2·482*	2·575*	..	2·283*	0·879*	1·167	..
Granny Smith	2·233*	2·830*	..	..	..	..	..	..
Gravenstein ..	1·618	..	..	..	..	..	..	..
Dougherty ..	1·850	2·549	1·336*	..	..	..	..	..
Ballarat ..	2·822*	..	..	5·028*	1·881*	1·420	1·380*	..
Other varieties	1·806	2·367	1·727	1·712	1·626	2·113	1·574	0·700
All varieties	1·807	2·351	1·951	1·756	1·706	1·305	1·346	0·692

* Under 1,000 trees in average.

and that therefore yields between different years are not strictly comparable. While this is true, it is contended that the difference between the age-constitution of two succeeding years is so small as to negative any shortcomings of this nature, and therefore the value of the information is by no means invalidated.

The data for 1929–30 were somewhat sparse, and the number of samples required was not so large as desirable; nevertheless, when presented, the results are of undisputed value to the grower. It is hoped that subsequent collections will not only remedy this, but also accumulate more material for deeper research and so enhance the value of the work generally.

A grower by taking his average yields for 1929–30 for those varieties shown in Table 10, dividing them into the average yield for 1930–31, and multiplying by 100 obtains a result which enables him to compare his progress in management with that of the other growers of his own district. If his result is lower than that shown in the table it would be advisable to seek the cause of the relative fall; on the other hand, if it is above it is a cause for personal satisfaction.

Table 10.—Comparative Annual Yields: Yields for 1930–31 expressed as a Percentage of 1929–30.

Variety.	Waitemata.	Hawke's Bay.	Nelson.	Mapua-Tasman.	Motueka.
Sturmer	..	95	106	105	102
Delicious	157	73	50	109	104
Jonathan	130	71	88	98	106
Cox's Orange Pippin ..	155	129	83	171	110
Dunn's	180	81	79	99	91
Statesman	..	71	76	132	98
Gravenstein ..	79	66	..	..	..
Dougherty	132	83	..	..	..
Ballarat	161	81	..	..	..
All varieties ..	130	82	87	107	101

It is the relative rise and fall between seasons that is compared, due consideration being given to the maturity factor. Another factor which has an important bearing in comparison of two succeeding seasons only is the biennial bearing habit of certain varieties. If a grower is endeavouring to improve his management he has no reliable guide as to what progress he is making because of seasonal fluctuations, a fact which is shown to have wide variation.

(To be continued.)

Botrytis Rot in Apples.—Mr. J. W. Whelan, Orchard Instructor, states that during the past fruit-export season botrytis rot was very much in evidence in the Wairarapa district. The disease was confined to two varieties, Cox's Orange and Jonathan, the latter being only slightly attacked. In Cox's Orange the disease was very prevalent, particularly so in those apples gathered at the first picking. During the latter part of the Cox's Orange season the disease had practically disappeared. The orchard in which the disease was most prevalent was heavily irrigated during the months of December and January.

COMMERCIAL FERTILIZERS AND THEIR BASIS OF SALE.

V. INORGANIC NITROGENOUS FERTILIZERS.

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1. Synthetic Nitrogen Products.

WITHIN the past ten or fifteen years the synthetic nitrogen industry engaged in the large-scale production of utilizable compounds from air nitrogen has made marvellous progress. Already the stage has been reached where it is producing at lower cost far more nitrogenous fertilizers annually than are produced from all other well known old-established sources such as Chilean nitrate deposits and the by-product ammonia plants of gasworks, &c., which in themselves are incapable of economically supplying modern international demands.

Quite apart from achievements in revolutionizing the production of standard nitrogenous fertilizers, this remarkably progressive industry has been responsible for introducing into commerce a great range of quick-acting combinations containing ratios of either one, two, or all three plant-foods—nitrogen, phosphoric acid, and potash—in double or treble the amounts contained in ordinary fertilizers. Throughout Europe, also in Asia, the United States of America, and certain tropical regions, very large quantities of the new synthetic materials are now either directly applied to the land or are used for raising and balancing the manurial content of factory-mixed fertilizers designed to suit special needs of crops and soils.

A number of synthetic brands carrying different formulas have appeared on the New Zealand market, and, although sufficiently large quantities have neither been sold nor experimented with to enable judgment to be passed on their performance, considerable interest has been evoked in their future opportunities and agricultural possibilities in comparison with the well-tried standard plant-food carriers. It has been claimed that, in consequence of having high proportions of beneficial nutrient matter in smaller volume, and the elimination of inert or low-grade constituents unessential to plants, such fertilizers are specially suitable for application in remote agricultural areas where high freight and distribution charges do not permit economical use of lower-grade fertilizing substances.

SIGNIFICANCE OF NITROGEN IN WORLD FERTILIZER PRODUCTION AND CONSUMPTION.

Before touching on the artificial conversion of atmospheric nitrogen into fertilizer, some indication of the very important position nitrogen from various sources has assumed in relation to modern agricultural and industrial needs is presented in Tables 1 and 2, data for which have been gathered from the most authoritative sources.

It will be seen that about 57 per cent. of the total production in terms of pure nitrogen comes from atmospheric sources, and of the total consumption of all fixed nitrogen,* including amounts from the two other

* The term fixed nitrogen denotes the direct chemical combination of nitrogen with other elements to form utilizable compounds. Farm-yard manure, fish, and other organic manures are natural sources of fixed nitrogen.

Table 1.—World Production and Consumption of Pure Nitrogen for Year ended 30th June, 1931.

	Tons.
Production :—	
Sulphate of ammonia—	
Synthetic	435,000
By-product	417,620
	842,620
Cyanamide	259,560
Other forms of nitrogen—	
Nitrate of lime	128,400
Synthetic	420,430
By-product	50,570
Chile nitrate	456,540
Total	2,168,120*
Consumption :—	
Manufactured nitrogen	1,561,402
Chile nitrate	358,045
Total	1,919,447*
Agricultural consumption included in total, about ..	1,722,000*

For the sake of illustrating what the total amounts of pure nitrogen would be in terms of solid nitrogenous compounds, the figures marked with an asterisk may be converted into equivalents of pure nitrate of soda on multiplication by 6·072, or pure sulphate of ammonia on multiplication by 4·715, with the following results :—

Equivalents.	Total Production. Tons.	Total Consumption. Tons.	Agricultural Consumption. Tons.
Nitrate of soda ..	13,164,825	11,654,880	10,455,980
Sulphate of ammonia	10,222,685	9,050,190	8,119,230

Of the total production, synthetic products amounted to 57·3 per cent., by-product to 21·6 per cent., and Chile nitrate to 21·1 per cent.

Table 2.—Estimated World Production of Fertilizers for Year 1928, showing Importance of Nitrogen.

Nitrogenous.*		Phosphatic.	
Fertilizer.	Quantity.	Fertilizer.	Quantity.
	Tons.		Tons.
Sulphate of ammonia	4,500,000	Bones	330,000
Calcium cyanamide	1,100,000	Basic slag	5,700,000
Nitrate of lime	965,000	Superphosphate	16,900,000
Miscellaneous salts† .. .	1,100,000	..	..
Chilean nitrate of soda	3,475,000	..	..
Totals	11,140,000	..	22,930,000

Potassic.		Nitrogenous-Potassic.	
Fertilizer.	Quantity.	Fertilizer.	Quantity.
	Tons.		Tons.
Potassic salts	5,700,000	Animal, &c., organic materials, chiefly valued for nitrogen	3,000,000
	5,700,000		3,000,000

* Amount of nitrogenous, including organic materials, in total production = 33 per cent. of all fertilizers. (Total world production = 42,770,000 tons.)

† Includes new synthetic materials: Ammonium-sulphate-nitrate, nitrophoska, ammonium phosphate, cal-nitro, ammonium chloride, calurea, potassium nitrate, &c.

largest contributors—the Chilean nitrate and the by-product ammonia industries—about 90 per cent. finds use in agriculture. The remainder is chiefly requisitioned for manufacture of high explosives. Other uses are for refrigeration and the manufacture of numerous chemicals. The phenomenal progress in production of air-derived nitrogen is instanced by the fact that twenty years ago only 25,000 tons were made, whereas last year's output was nearer 1,250,000 tons, equivalent to, say, 7,590,000 tons of pure nitrate of soda.

Conversion of Atmospheric Nitrogen into Fertilizer Compounds.

Fixation of nitrogen from the air into compounds indispensable in agriculture, industry, or war is capable of being rapidly carried out by various complicated and rather costly technical processes. Three methods are, or have been, widely exploited, the chief and most successful being the direct synthetic ammonia process, originating out of the inventions of Haber and Bosch, two German technologists. Two older, less used methods are known as the "cyanamide" and the "arc" processes respectively. Modifications of the original system of Haber-Bosch which possibly may be regarded as distinct processes have, of course, been adopted by numerous nitrogen-fixation firms, who have elaborated on ideas and inventions pertaining to the production of ammonia (nitrogen plus hydrogen) by direct synthesis.

The fixing or holding of atmospheric nitrogen in utilizable forms of compounds such as ammonia or nitric acid is, for the most part, merely a preliminary to further conversion into suitable materials for trade. Various inorganic nitrogenous salts in solid form carrying rapidly water-soluble plant-nutrient matter may be made to formula by uniting synthetic ammonia, not suitable under ordinary conditions for fertilizer use alone, with sulphuric, phosphoric, hydrochloric, or carbonic acids to form the respective sulphate, phosphate, chloride, and carbonate salts of ammonia. Likewise nitrates may be formed by neutralizing nitric acid, synthesized from air nitrogen, with basic substances—lime, soda, or potash—to form respectively nitrates of lime, soda, and potash.

The four main compounds processed from air nitrogen are sulphate of ammonia, calcium cyanamide, and the nitrates of lime and ammonia. Complete fertilizers with high concentrations of plant-food—for example nitrophoska—referred to earlier in this series of articles are made by combining either ammoniacal or nitrate forms of nitrogen with phosphoric acid and potash.

Haber-Bosch Process.—This system, developed for many years exclusively in Germany, involves the use of air, coal, and water as main raw materials. To-day, however, it is extensively exploited throughout Europe and America. The operation of the process depends on the direct union of air nitrogen with hydrogen, the latter being obtained from water by electrolysis or from coal. Although not so much depends upon cheap electric power as with the other two systems discussed further on, the process requires a great amount of technical skill in manipulation. The synthesis is carried out under conditions of high temperature and pressure; the ammonia solution ultimately produced being the starting or primary material for production of many different forms of combined nitrogen, such as nitrates or ammoniates, as the

case may be. Mention may be made of the Ostwald process, with the aid of which ammonia is convertible into nitric acid. From nitric acid various nitrates can be built up either for military or fertilizer use.

The first commercial Haber plant, with a capacity of 25 tons daily, commenced operating in Germany in 1913. To-day 91 out of an estimated 126 or more air-nitrogen plants are reported to be based in some way on the Haber-Bosch principle. Even if a large number of these plants are looked upon as functioning as distinct processes—such as the Claude, Fauser, and Casale—a notable point is that the greater portion of synthetic nitrogen materials produced has come from a few very large installations which are equipped with the Haber-Bosch apparatus. The two immense works, occupying an aggregate area of almost 2,000 acres, belonging to the German chemical organization I.G. Farbenindustrie A.G., together with the great up-to-date efficient works of Imperial Chemical Industries at Billingham, Stockton-on-Tees, the largest in the British Empire, are capable, if need be, of turning out anything up to 1,000,000 tons of pure nitrogen yearly by the direct synthetic method of ammonia production.

Experts affirm that future international demands will be satisfied principally by the Haber-Bosch process or modifications thereof, as definite advantages are held by it over all other systems of nitrogen fixation. An indication of the latest trend is exemplified by the construction of a small Haber-Bosch works—presumably the first in the Southern Hemisphere—near Johannesburg in South Africa. Japan apparently is also operating a large lately constructed plant (capacity 235,000 tons of fixed nitrogen annually) with the Haber-Bosch equipment.

The Cyanamide Process.—This was one of the earliest to be exploited. The first factory commenced as far back as 1906, but notwithstanding such an early beginning the process has made far less progress than the direct synthetic ammonia method. For economic manufacture of calcium cyanamide, the principal marketable article of the system, cheap sources of electric energy, coal, and limestone are essential. Such countries as Norway, Sweden, Italy, Switzerland, Canada (at Niagara Falls), &c., where abundant water-power for generating electricity is available, have been selected hitherto as suitable locations for erection of plants.

The bare outline of procedure for production of cyanamide is as follows: Lime and coke are brought together at red heat in an electric furnace to form calcium carbide, which is broken up and packed into a smaller electric oven, and pure nitrogen separated from the atmosphere by a special liquefaction process is then introduced. The carbide mixture is well heated to enable the nitrogen to be absorbed or fixed by the carbide to produce the calcium cyanamide.

Calcium cyanamide can be changed into ammonia, the preliminary material from which further products, such as ammonium phosphate, can be manufactured. Urea, a well-known concentrate briefly described further on, is also obtainable from cyanamide.

In spite of many reported defects, the "cyanamide process" is still producing combined nitrogen in considerable amounts; Germany had a production of roundly 408,000 tons of cyanamide in 1930, while Canada with 142,000 tons, and Poland with 125,000 tons follow. (See Table 2 for world production in 1928.)

The Arc Process.—The commercial operation of this process depends on the passage of ordinary air through an electric arc furnace to promote direct combination of nitrogen and oxygen at the temperature of the arc to form nitric oxide, a gas which is convertible into nitric acid for the preparation of nitrates.

Numerous authorities now appear to be convinced of the inefficiency of the arc method for production in relation to the extraordinary amount of power consumed. In Norway, where cheap electric power is obtainable, the process worked relatively well until recently in providing large quantities of nitrate of lime, &c., for trade. However, the output of the same material at German works where the Haber-Bosch apparatus is installed far exceeds the recent Norwegian production of this commodity. Very few plants function on the arc principle to-day, the tendency even in Norway being for their replacement with direct synthetic ammonia units. In 1930 Germany produced 350,000 tons of nitrate of lime, against Norway's 149,000 tons.

SYNTHETIC NITROGEN PLANT-FOOD CARRIERS.

As many factors play a part in determining the effectiveness of various nitrogenous fertilizers in practice, only very general and abridged statements will be made here regarding their properties or behaviour.

Sulphate of Ammonia.—Not only is this the chief fertilizer of the air-nitrogen industry, but it is also produced in large quantities as a by-product of the coking and coal-gas industries.* As a fertilizer it is very well known, widely used, and comparatively cheap. It holds first place in world nitrogen production (see Table 1), and for the greater part is the product of large ammonia plants.

The first method of manufacture several years back was dependent upon the treatment of ammonia with sulphuric acid in order to obtain the sulphate, but on account of the scarcity of sulphur deposits for making sulphuric acid, gypsum (sulphate of lime), which occurs in abundant natural deposits, was found to be a satisfactory substitute for sulphuric acid. The latter procedure is followed by the English chemical organization working a modified Haber-Bosch nitrogen plant at Billingham and by the German works at Leuna and Oppau. All three installations have been built within easy reach of extensive gypsum deposits.

The method of production is briefly as follows: Gypsum meal, suspended in water, is churned with ammonia and carbon dioxide, resulting in the formation of carbonate of lime and sulphate of ammonia, the solution of the latter being subsequently evaporated to dryness to obtain the saleable article. The precipitate of lime carbonate, after being filtered off and dried, is combined with ammonium nitrate, thereby enabling the commercial production of new types of plant-food carriers sold under the names of Nitro-Chalk and Calnitro, &c., which are dealt with later.

Sulphate of ammonia is a whitish, crystalline, readily soluble salt without odour. Generally it is bought on a guarantee of 20·6 per cent.

* By-product sulphate of ammonia, together with Chilean nitrate of soda, will be briefly treated in a continuation of the present article.

nitrogen. Two types have been procurable locally within recent years—the dry neutral and the acid type. The latter, a by-product of a few old fashioned coke-oven or coal-gas plants, contains usually a small amount of sulphuric acid (from 0·1 to 0·3 per cent.), which causes bag-rotting and loss of physical condition. The dry, neutral material from large up-to-date plants has a much better mechanical condition for drilling or sowing by hand. In addition, it does not take up moisture from the air and become sticky quite so readily as nitrate of soda or other nitrates.

The recently developed practice of directly ammoniating superphosphate with either gaseous or liquid ammonia obtainable at low cost lends itself readily to the more economical manufacture of manurial mixtures. In the United States, in particular, the practice has become well established in that it avoids the expensive process of converting ammonia through the intermediate stage of sulphate of ammonia. More recently a solution of ammonium nitrate in ammonia has been favourably considered as an alternative to ammonia alone for treating superphosphate. Apparently it is customary for both synthetic and by-product ammonia to be delivered to fertilizer-works in specially designed steel-tank cars, the contents of which can be diluted with water and sprayed on to superphosphate for absorption.

Sulphate of ammonia employed in local farm practice at the present time is of the synthetic type from Great Britain. Most of it is either in the first place utilized by commercial mixers for preparation of ammoniated superphosphate, &c., or is applied to pastures and general farm crops in conjunction with phosphates and potash. Small amounts also go to top-dress lawns, golf-greens, &c. That increasing quantities have been used within recent years is manifested from importation returns: From 1912 to 1921 3,800 tons were delivered to the Dominion, in comparison with 26,900 tons for the period 1922 to 1931. The quantities of Chilean nitrate of soda imported for the same periods were 3,736 and 10,722 tons respectively.

Nitrate of Ammonia.—This is a highly concentrated, rapidly acting compound containing 35 per cent. of nitrogen, half being as ammonia and half as nitrate. Its manufacture is accomplished by converting ammonia into nitric acid, which is neutralized with more ammonia to form the nitrate. For explosives-manufacture it is of importance, but as a fertilizer it has the property of absorbing moisture from the air, which constitutes a drawback to its physical condition. Another disadvantage is its liability to explode when subjected to violent detonation or brought into contact with fire. In mixture with certain other materials it is quite safe for use.

Nitro-Chalk.—About 44 per cent. of nitrate of ammonia occurs as the plant-food carrier in this comparatively new addition to the fertilizer trade. Apart from having 15·5 per cent. of water-soluble nitrogen—half as nitrate and half as ammonia—nitro-chalk contains 48 per cent. of precipitated lime carbonate. Not only does this render the ammonium nitrate safe for handling and lessen its hygroscopicity and thus improve its mechanical condition, but also tends to reduce soil-acidity. Nitro-chalk is available in granular form chiefly to British consumers from the Billingham air-nitrogen factory, at a considerably lower price than Chilean nitrate of soda.

Calnitro.—A proprietary product of German works, of slightly higher strength, but nevertheless similar to nitro-chalk. An interesting feature of this product is that its granules are coloured green to facilitate identification. The practice of giving a distinctive colour to certain synthetic preparations shows promise of extension, as further new grades come forward. Calnitro has 35 per cent. of precipitated lime and 20·5 per cent. of nitrogen in its composition. To preserve its mechanical condition it is packed in moisture-resistant bags. Minor quantities of it have been used in our Canterbury wheat-lands and for various other experimental purposes.

Leunasalpeter.—A concentrated double salt of nitrate of ammonia and sulphate of ammonia prepared in large quantities in Germany. It is guaranteed to analyse 26 per cent. of nitrogen, a quarter being as nitrate and the rest as ammonia.

Kali-ammon-salpeter.—Another German formula stated to be of good physical properties, and consisting of a mixture of chloride of potash and nitrate of ammonia. The analysis is 16 per cent. nitrogen and 27 per cent. potash.

Chloride of Ammonia.—A yellowish-brown salt of good physical character, containing 24–26 per cent. nitrogen, prepared by treating common salt with synthetic ammonia and carbon dioxide, which results in the formation of bicarbonate of soda and chloride of ammonia, the latter being separated from the former. Owing to its high cost until lately it has not found much sale, but in Europe to-day large amounts are marketed. In efficiency it is said to compare very well with the sulphate form of ammonia. A further combination of chloride of ammonia with chloride of potash (10–11 per cent. nitrogen and 20–24 per cent. potash) sold under the name of potazote is a special line developed and marketed in France.

Large quantities of synthetic ammonia are also employed in the preparation of phosphates of ammonia, &c., as dealt with in an earlier article of the present series (*Journal*, September, 1931).

Urea.—This is produced when ammonia and carbon dioxide are brought together under suitably controlled conditions. It is a white, fine, crystalline substance with an exceptionally high concentration—46 per cent. of water-soluble nitrogen in organic form.* The pure article leaves no alkaline or acid residue in the soil, and gives a somewhat slower response than either nitrate of soda or sulphate of ammonia in assisting vegetative growth.

Manufacture of urea is conducted on a large scale in Germany, the product being put up in special moisture-resistant containers. From this source small quantities have been retailed for local market gardens, &c., but owing to its moisture-absorbing qualities interfering with its physical condition, a little difficulty has attended its utilization. From all accounts good use has been found for it in Auckland Province when suitably mixed with dry ground rock phosphate.

Rothamsted reports (1927–28) refer to urea as comparing favourably with sulphate of ammonia in field trials. Moreover, having the

* Although urea, cyanamide, and derivatives of urea contain organic nitrogen, they are included in this article for the sake of convenience.

advantage of containing 46 per cent. of nitrogen, as compared with 20·6 per cent. in sulphate of ammonia. it should prove useful for saving weight in transport to remotely situated farms.

Calurea.—A high-analysis combination of nitrate of lime and urea, with one-fifth of its nitrogen (6·8 per cent.) as nitrate and four-fifths (27·2 per cent.) as urea. It is likewise manufactured in Germany, and has a physical condition similar to urea.

Phosphazote (Superphosphate of Urea).—Containing 7 per cent. of nitrogen and 12 per cent. of phosphoric acid, this is a special compound converted from cyanamide in certain French and Swiss factories.

Urea-Potash-Phosphate.—Another specially developed proprietary line of very high fertilizing quality, which has appeared on the European market. This complete combination, reputedly well-adapted for market gardens and for saving bag and transport costs, contains 28 per cent. of nitrogen in three different forms—nitrate, ammonia, and amide—as well as 14 per cent. of potash and an equal amount of phosphoric acid. It consists of a mixture of urea, diammonium phosphate, and nitrate of potash in certain proportions.

Cyanamide of Lime (Calcium Cyanamide).—A grey to black powder or granular material of rather peculiar chemical properties, manufactured by the cyanamide process. The modern product has a distinctly improved mechanical condition, being easily drillable compared with the earlier article Nitrolim. In Europe and the United States cyanamide, although sold for its nitrogen, is popular as a drier or conditioner of mixed manures, and it is in this particular direction that attention is centred on it in the fertilizer market. Commercial grades contain usually about 20–22 per cent. of insoluble cyanamide nitrogen, together with 22 per cent. or more of free lime and 10–12 per cent. carbon, which latter gives cyanamide its black colour. Added to the free lime it has lime in combination as calcium cyanamide, giving it a total content of 60 per cent. (or 1,344 lb. per ton) of lime or more. Cyanamide in comparison with other normal strength nitrogen fertilizers is reasonably priced.

By reason of the high lime content referred to the product leaves an alkaline residue in the soil, which is capable of effecting an appreciable reduction of soil acidity. If unsuitably stored it undergoes deterioration, forming a complex poisonous compound—dicyanodiamide—injurious to young plants. Even under normal conditions the customary plan is for cyanamide to be applied before seeds or plants are put into the soil owing to its injurious effect on seed-germination or tender growth when brought into close contact.

As now marketed the material after having been subjected to an oiling process is far more easily handled than the dusty, cruder product of former years. At times, even after oiling, there is a tendency for certain grades to cause skin inflammation to users. For destroying weeds unoiled raw cyanamide has considerable utility. In Great Britain and on the Continent of Europe it is in good demand for the destruction of charlock and cornflower, two troublesome weeds in cereal crops.

Nitrate of Lime.—This is the lime salt of nitric acid. A standard grade commodity which has until recently been made principally in Norway by the electric arc process, but large quantities are now prepared from synthetic ammonia at German air-nitrogen factories. Commercial samples yield 15·5 per cent. of nitrogen and 28 per cent. of free lime.

Like many more crystalline synthetic compounds it tends to deteriorate physically through absorption of atmospheric moisture, necessitating special treatment with oil for checking its deliquescent properties as well as the use of drums or waterproofed bags. In productive value this salt is on a level with nitrate of soda, its lime content being of advantage for effecting decreases in soil lime-requirements.

Nitrate of Soda.—A pure, granular product with much the same characteristics as Chilean nitrate. It is manufactured synthetically in Europe and the United States from ammonia oxidized into nitric acid, which is made to react with soda ash to form nitrate of soda, subsequently obtainable in the solid state by evaporation. Notwithstanding the complicated nature of the apparatus required for its manufacture, the product is reasonably priced. On the English market it is quoted at approximately the same figure as Chilean nitrate of soda by Imperial Chemical Industries, who have commenced the manufacture of small quantities at Billingham.

Nitrate of Potash.—This concentrated crystalline salt of fairly good physical properties, yielding 13 per cent. nitrogen and 44 per cent. potash, has also been procurable lately as a synthetic substance. Well recognized to be of a highly stimulating character, this product is specially useful for market gardens, fruit crops, &c., and for incorporation in mixed manures. At one time it was expensive and difficult to procure on account of production being chiefly confined to natural deposits in India, but since the advent of the synthetic means of manufacture, its price has dropped considerably.

Sale and Utilization of Nitrogen.

It will be readily observed from the foregoing descriptions that a wide range of novel compounds have been skilfully developed ; indeed, their many different formulas, variations in price, and unusual appearance are quite a feature of the modern fertilizer trade. Quite likely the discrimination shown by agriculturists for different types of nitrogenous fertilizers in the past and the fact that some have a wider utility than others has partly accounted for this exceptionally wide choice. Another reason may be due to the efforts of manufacturers to comply in a general sort of way with one of the fundamentals of fertilizer practice—namely, that full benefit can be obtained from a fertilizer only if its ingredients are so balanced as to be suitable for particular soil conditions and crop requirements.

The comparative agricultural values of different types of nitrogenous materials have formed, of course, the subject of countless field trials, but the fact remains that the experimental stages have by no means been passed in respect of some of the newer compounds. There is every possible chance that research now in progress will point the way to their proper use. Discoveries of further new substances and technical improvements in manufacture are also to be justifiably expected. To this latter end there is a noteworthy move toward improving the quality of certain concentrated nitrogenous types by introducing more lime into their composition to provide for the leaving of beneficial alkaline rather than unwanted or harmful acid residues in certain classes of soil. Every effort, too, is being directed to the amelioration of defective physical condition of otherwise attractive materials, and in manufacturing suitable mechanical devices for their economical distribution.

A few years ago the employment of inorganic nitrogenous fertilizers could not always be regarded as an economic proposition, but with the modern electro-chemical mass methods of manufacture it is not improbable that prices—especially of nitrates—will come down to an even lower level than at present. Consumption of nitrogen in New Zealand agriculture, although relatively insignificant, will doubtless slowly increase with the more intensive development of farms and orchards as time goes on. On the other hand, the importance of utilizing natural nitrogen resources by the ploughing in of legumes, &c., as well as the conservation of live-stock manures, cannot be overlooked.

(To be continued.)

GERMINATION CAPACITY OF PERENNIAL RYE-GRASS IN RELATION TO PRICE.

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THE opinion that perennial rye-grass seed will not germinate well artificially and that some special property of the soil is necessary to induce complete or nearly complete germination is being given publicity in certain districts. It is understood that many buyers of certified rye-grass seed have practised a very doubtful economy in purchasing lower-priced lines on the understanding that the seed will germinate quite satisfactorily in the soil. Notwithstanding reports of "wonderful strikes," &c., the field germination percentage of practically all grass and clover seeds is invariably lower than that obtained artificially in a germinator. Any statements to the contrary may be disregarded entirely. It has been shown that the non-germinating seeds in low-germinating lines of perennial rye-grass are abnormal, and that, as the germ is non-existent, growth under any circumstances cannot take place.*

At a price commensurate with the quality of the seed offered, some buyers may find good value, but at the reported prices paid for some of the lines offered, the value received in pure germinating seed is, per shilling expended, very much lower than were higher-priced, high-quality seed purchased. Seed-vendors are business men, and if in the vendor's opinion a line of certified seed is worth only 6s. to 8s. per bushel, when first-grade is selling at two to three times as much, then it may be taken for granted that, notwithstanding a reputed field performance, the line under offer is not up to standard in some particular.

Relevant also is the idea, given some publicity last year, that seed of perennial rye-grass of superior type invariably shows a very low germination percentage—in fact, that the lower the growth percentage the more superior the type as a perennial. There is no evidence to suggest any direct relationship between strain and capacity to germinate. It is true that in certain districts the perennial strains appear to be more susceptible to conditions which result in the loss of the viability of a large proportion of the seeds.* The germination capacity of seed of perennial rye-grass grown under conditions suitable to seed-production is invariably very high, as is evidenced by this season's average germination percentages of 98, 96, and 97 for Hawke's Bay, Poverty Bay, and Canterbury certified seed respectively.

*See *Journal*, May, 1932.

THE WASTE LANDS OF NEW ZEALAND.

AN UNDEVELOPED ASSET.

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Introduction.

THE principal kinds of waste lands in New Zealand* are: (1) The dune sands, and (2) the estuarial mud-flats, lagoons, shallow lakes, and other areas permanently or temporarily submerged by fresh, salt, or brackish water which exist throughout the Dominion. The surface of the dunes is broken in contour, and ranges from sea-level up to 200 ft. in elevation. It is sparsely colonized by plants which have a specialized structure enabling the plant to resist drought and burial by moving sand. The surface of the second type of waste land is unbroken save for cracking on drying and occasional shallow creek-beds. In most cases the area is little raised above sea-level. The vegetation of this type varies from nothing to mangrove associations—that is, small forests—and may include pure associations as eel-grass (*Zostera*), salt-weed (*Salicornia*), sea-rush (*Juncus maritimus*), or Purua grass (*Scirpus maritimus*).

It is intended to deal in greater detail with these waste lands in subsequent contributions; for the present it will be sufficient merely to introduce the subject with some general observations.

The utilization of New Zealand lands, especially those of the North Island, has been generally initiated by occupying areas which offer the least resistance in the first years to colonization by remunerative plant-growth. No consideration in the past was given to the question of available or total plant-food in the soil or to the physical state of the soil. Lands were classified on consideration by the practical man on what other lands which looked similar would do; and if pasture plants grew well on any portion of the area it was assumed that the animals eating those plants would also grow well, an assumption which has proved to be untenable for great areas of coarse-textured soil ranging from sands to fine gravels in the bush-sick region. With this exception, the methods of opening up lands for settlement have worked well on the whole, with the aid of many millions of tons of imported phosphate which it has been necessary to apply in order to reinforce the naturally poor plant-food content of average North Island soils. Soils naturally rich in phosphates and lime have been neglected because they offered engineering difficulties in bringing them into profit. One apparent exception to this is the great drainage policy by which such areas as the Hauraki Plains and the Rangitaiki Swamp have been dealt with and successfully brought under farming occupation. But these are not really exceptions, since only a relatively small portion of them is exceptionally rich in available phosphate or lime.

THE SAND DUNES.

A very large area—stated to be 300,000 acres—of sand dunes, is available for reclamation. The examination of only a small part of these has been completed for chemical analyses, but if those areas which

* By "waste lands" is meant those areas not growing forest, native flax, grasses, or other plant staples in sufficient quantity to warrant utilization.

have not been examined are as rich in phosphates and lime as those of the Manawatu district, then a great tract of land is available for reclamation, with mineral plant-food present in abundance which would rapidly grow many green-manuring crops for reinforcing the deficient organic matter. Such land has the advantage that it can be worked in all weathers, and, being contiguous to the sea, could be connected up with adjoining occupied areas, fenced, roaded, watered, and bridged at a moderate cost compared with the cost of doing this in most new settlements, which are usually at a distance from rail or harbour.

The large quantity of those elements, phosphorus and calcium (usually so deficient in New Zealand soils), in lands but recently derived from the sea, is due to the abundance of marine life which has concentrated in the animal and plant remains—the calcium and the phosphorus derived from the sea. In many places when primeval man or early settlers have had their homes by the sea they have also contributed a share of the phosphates so abundant on littoral situations, and it should be remembered that the phosphate in these areas is largely available—that is, it is equivalent to a recently applied dressing of superphosphate. This may be partly due to the presence of excessive calcium which prevents the reversion of phosphate to an unavailable form, and partly to the solvent action of sodium derived from the sea-water in attacking the rocky material chemically and disintegrating it.

The sterility of the dune area immediately contiguous to the sea is often thought to be due to sea salts, but analyses of these sands affords no support to this idea, although the time at which the maximum amount of salt is present may have been missed at any time the samples were drawn ; but certain it is that no analysis shows any such high content of chlorides as would account for the sterility of the fore-dune and some of the after-dunes. It may be that the alkaline reaction of such sands is inimical to the growth of ordinary pasture-plants, although such specialized grasses as the naturalized marram (*Ammorphila*), the beautiful silvery New Zealand spinifex, and the pingao sedge (*Scirpus frondosus*) are able to flourish on the fore-dune. The point has rather an important economic bearing, as if the alkaline reaction of sands is proved to be the cause of the sterility for ordinary pasture plants it would help to establish the recognition of the fact that it is unsafe to lime sandy soils like pumice lands, owing to the bad effects on the stock and the lack of response in the pasture.

In the transformation by plant life of raw mobile sand full of small pieces of shell into grassed dune suitable for grazing stock lime-loving or lime-tolerating plants assist and flourish at the coast. These, as one proceeds inland, gradually become less aggressive, less healthy, finally disappearing and giving place to plants which flourish in or at least tolerate a neutral or acid soil. The organic matter accumulates now, forming an acid sandy soil, and this is a suitable medium for the growth of pasture plants. These eventually form a sward which the wise farmer does not attempt to improve by cultivation and resowing, but relies on top-dressing, because once the covering of humus is destroyed, it may be difficult to obtain a sward again on sand.

* Crystals of pure phosphate of lime (apatite) occur in Taranaki ironsands.

One of the most interesting researches on sand dunes is that of Dr. E. J. Salisbury, dealing with the Southport (England) dunes. This worker was able to correlate the change in chemical and botanical composition with the age of the dune. There is a recession of the sea at Southport, and the age of each series of dunes can be learnt by reference to old maps, one dating so far back as 1610. The chief change is the leaching out of the calcium carbonate of the sea-shells, and the change in the reaction from being alkaline on the two-year old dunes (pH 7·2–8·2) to decided acidity at those dunes over two hundred years old (pH 6·2–5·5).

The gradual transformation of the plant covering from what are known as lime-loving plants (calcicoles) to lime-hating plants (calcifuges), is well shown in researches on dune vegetation generally. Every gardener knows that it is fatal to lime rhododendrons, which belong to the great Erica family represented in England and New Zealand by such plants as ling (*Calluna*) and the other heaths, and the growth on this type of soil is indicative of the changed quality of the soil, which, with the leaching-out of the calcium carbonate, has become acid. Manuka (*Leptospermum*) is a New Zealand plant that will not tolerate an alkaline soil. Accordingly, this is found at the back of the outer fore-dune and not on it, for here the lime-requirement is negative. Occasional manuka plants may occur close to the inner fore-dune, but the growth is not aggressive. At Southport the "Heather Dune," 280 years old, contains only 0·03–0·19 per cent. of calcium carbonate (pH 5·5).

What nature can accomplish in 280 years in fixing and populating with plants the shifting dunes, man can accomplish in a much shorter time by introducing more rapid methods of improvement—the engineer to level, road, and bridge, and the agriculturist to reinforce a sparse organic matter content by growing special crops for fixing the sand, for ploughing in, or for sale, these special crops being able to flourish in the special environment. The special pasture staples may be quite as good as those commonly used; for instance, it is known that strawberry clover (*Trifolium fragiferum*) will grow in brackish water and is equal to white clover in results when fed to stock. Experimental areas on the dunes are needed so that systematic observations may be recorded.

The results of the examination of the Manawatu dunes may be found in Volumes 20 and 21 of this *Journal*. It is thought that there is a recession of the sea on this coast, one landowner stating that the rate at which this is taking place amounts to a chain in ten years, so that if this has been uniform throughout the breadth of the dunes it would have taken 800 years for the shore to progress a mile seaward. Half a mile to a mile from the sea there is, however, now still about four times the available phosphate that there is in ordinary New Zealand soil, and 1 per cent. of calcium, which is more than twice the amount found normally. The grazing value of the fixed dunes is very variable, as the inter-dune land is often wet and even swampy, which affords stock a complete change of pasture from the somewhat short, dry, poorer grasses of the dunes. Some of the drained swamps which have been converted from flax (*Phormium*) to dairy pastures support quite high-class pasture.

These Manawatu dunes exist in a region of good rainfall—about 40 in.; also there are sometimes droughty spells in summer. Enough rain, however, falls to grow many green-manuring crops, and there is evidence that the material composing the sands, although of fairly uniform size (technically speaking, "fine and coarse sands") have not been weathered as much as dune sands in most other parts of the world where they have been the subject of research. Usually dune sands consist of the harder portions of rock matter which is largely quartz (oxide of silicon or silica), a substance which supplies little or no plant-food. Such dunes are usually white or yellowish, whereas the Manawatu dunes are of a distinctly drab colour, which betokens a large admixture of the original unweathered rock whence the sands were derived. This has a direct effect on the fertility of the Wellington dunes. The experience of those who have made gardens on dunes, and who have taken the trouble to apply organic manures liberally, is that there is no finer material upon which to garden.

The Brackish or Salt Lakes, Lagoons, and Estuaries.

These areas are now receiving considerable attention from public bodies in New Zealand, who contemplate land-reclamation on a large scale assisted by labour at present unemployed. No more fascinating problem has presented itself for years than the utilization of these potentially valuable waste lands, now either slightly submerged or abandoned to wild inedible plants, the animal life there finding a congenial home and constantly enriching the area with phosphates.

Throughout the many contributions on New Zealand soils scattered in this *Journal* and other official publications during the last thirty years, the fact is prominently patent that littoral lands of all kinds are worthy in the highest degree of the engineer's and farmer's attention. They are often more accessible than the sand-hills, many areas being close to the cities and other densely populated centres. For the same reasons that the sand dunes are so rich in mineral matter other than silica—that is, the material has not travelled far and is imperfectly weathered—the estuarial lands have not reached in many cases that stage which is found in Europe under similar conditions, where a stiff soil or clay composes the bed of the type of land now being drained. In New Zealand these lands are composed of sand, silt, clay, and shells in well-balanced proportions, and these components, theoretically, ought to make the best of all soils technically known as loams.

Attention in the world of agricultural science is now being directed to the gigantic scheme of the Dutch authorities in draining the Zuyder Zee. An International Soil Congress is being held at Groningen this month from which much of interest may be learnt, as provision has been made whereby the Dominion will be represented, and members will visit the reclamation site. The problem in Holland is complicated by the fact that the land when drained will be a clay soil. Clay makes the most intractable soil to work at any time, but when salt water has been mixed with the clay the treatment of the soil is rendered more difficult and the utilization of the land is delayed.

In New Zealand heavy or clay soils are the exception rather than the rule, and it is anticipated that the estuarial lands when drained will

offer no great difficulty in the rapid leaching away of injurious sea-salts. In some cases shell beds alternate with mineral matter, mud, silt, or sand. In times of exceptional deposition from floods the sea animals have evidently been killed out, and the shells, largely carbonate of lime, when mixed with the mineral matter in cultivating will, it is hoped, mitigate or altogether prevent any ill effects which may result from the action of sea salt on the clay particles.

On some of these reclaimed lands special crops may have to be grown at first. Most vegetables will grow admirably on light soil with a fair percentage of salt in it, as the ancestors of these vegetables originally inhabited a coastal situation. Thus all the cabbage family is derived from the colewort, a maritime plant, and the beet and mangold from *Beta maritima*. Nearly all the cress family (Cruciferae), such as mustard, kale, rape, radish, and kohlrabi, are suitable as crops in salty situations, but probably the most payable of all for market-gardening purposes will be asparagus, of which in 1930, 93 tons were imported tinned, mostly from America, valued at £7,000. Why could not this have been produced in New Zealand, and why could not vegetable produce of all kinds be exported from this country where it is so easily grown ?

The Hauraki Plains soils near the sea contain six times the amount of available phosphoric acid that exists in ordinary soil (see this *Journal*. June, 1914, p. 574). The Lake Ellesmere (Canterbury) lagoon, occupying 100 square miles, is equally rich in phosphate. The Nelson (Wakapuaka) mud flats (see this *Journal*, August, 1919, page 78) contain about four times the phosphate, the Lake Grassmere (Marlborough) two and a half times, the Blueskin Bay (Otago) four times, and the Napier (Ahuriri) lagoon three to four times the amount of phosphate normally found in fertile soils. These figures are considerably on the low side where there is much carbonate of lime present, which interferes with the method used in spite of corrections made to prevent it.

(To be continued.)

STOCK SLAUGHTERED, 1931-32.

FOLLOWING are the numbers of stock slaughtered at abattoirs, meat-export works, bacon-factories, and ordinary registered slaughterhouses throughout the Dominion during the year ended 31st March, 1932 :—

Stock.	Abattoirs.	Meat-export Slaughter-houses.	Bacon-factories.	Ordinary Slaughter-houses.	Totals 1931–32.	Totals 1930–31.
Cattle ..	135,224	131,624	..	56,094	322,942	326,128
Calves ..	54,461	537,003	..	1,565	593,029	551,760
Sheep ..	788,045	3,430,176	..	246,673	4,464,894	3,564,005
Lambs ..	199,377	8,459,244	..	30,575	8,689,196	8,092,802
Swine ..	131,369	246,048	31,808	21,689	430,914	449,490

—*Live-stock Division.*

ORCHARD SPRAYS IN NEW ZEALAND.

III. THE COPPER SERIES.

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CERTAIN copper salts are among the most valuable fungicides known, and, together with sulphurs, form the principle fungicides in use in commercial orchards. Copper sulphate was the first copper spray to be employed, according to Lodeman (1913), for about 1881 it was used in France in the form of a 1-per-cent. solution as a winter wash to combat black-spot of apple-trees. The results secured were of uncertain value, so that the fungicidal properties of copper were really not recognized until the application of bordeaux mixture in 1883. Subsequently, numerous combinations were tried in which copper sulphate was combined with ammonia or soda, leading to the production of the lesser-known cupramonium and burgundy sprays.

As bordeaux mixture is the most important of the copper sprays, it is discussed first in this article, other copper sprays being dealt with in the second part to follow next month.

1. Bordeaux Mixture.

The discovery of this fungicide was made by Millardet in October, 1882, when passing through the grape-growing district of St. Julien in Medoc, about twenty-five miles north of the city of Bordeaux, in France. He noticed that although the leaves had fallen from vines throughout the district (owing to the ravages of downy-mildew, *Plasmopara viticola*) they still adhered to plants bordering the roadside. On investigating the reason for this he found that it was the practice for growers in this region to sprinkle with verdigris or a mixture of copper sulphate and lime the leaves of vines contiguous to the roadsides, with a view to making them appear as if poisoned, and thus act as a deterrent to petty thieves. Millardet rightly concluded that the persistence of the leaves of plants so treated was in some manner connected with the materials used, and accordingly arranged for a series of tests to be conducted in the following year. As a result, he found that of the numerous salts of metals tested the combination of copper sulphate and lime gave most promising results as a controllant of downy-mildew.

The first formula recommended in consequence of these preliminary experiments (17–33–25) produced a thick paste, which of necessity had to be sprinkled on to leaves and fruits with fibre brushes made of bundles of twigs bound firmly together (Millardet, 1885). Millardet, with the assistance of the chemist Gayon, then modified the proportions, and introduced an improved formula in which the copper sulphate and lime were in the proportions of 3–1–11 (Millardet and Gayon, 1887). The formulæ and methods of preparing this spray have subsequently undergone numerous changes, as will appear, and even to-day finality has not been reached.

The common name of this spray, bordeaux mixture, is a translation from the French (*boullie bordelaise*), and is derived from the district in which it originated.

Composition of Bordeaux Mixture.

Bordeaux mixture is prepared by bringing together solutions of copper sulphate and lime. Combination takes place between the copper sulphate and lime with the formation of a chemical compound, the composition of which differs according to the proportions of the chemicals used. Copper sulphate is readily soluble in water, for 1 gallon will dissolve slightly less than 3 lb. at a temperature of 60° F.; but lime is only slightly soluble, since 1 gallon of water at 60° F. will dissolve but 0·27 oz. of the hydroxide, and the solubility actually decreases with an increase of temperature.

It would appear that the first reaction that takes place following mixing of these two compounds is the formation of a chemical compound known as a basic sulphate or trioxysulphate, $4CuO.SO_3$ (Pickering, 1907; Martin, 1932). Should there be less or just sufficient lime present to precipitate the whole of the copper, no further chemical action takes place. This condition is reached when the ratio is in the proportions of one part by weight of copper sulphate to 0·169 part of calcium hydroxide = approximately 6 : 1, or, in chemical equivalents, 1 : 0·75 (Millardet and Gayon, 1887; Pickering, 1907; Martin, 1932). Should lime be added in excess, further reactions occur, and the nature of these has been the subject of considerable diversity of opinion by many of those who have studied the subject.

The most recent explanation as to what happens is that of Martin (1932), who, by applying electrochemical methods, was able to demonstrate that when calcium hydroxide was added in excess of this 1 : 0·75 ratio of chemical equivalents, the trioxysulphate was decomposed slowly until a ratio of 1 : 1 was reached, at which point permanent alkalinity was attained. During this addition the sulphate radicle is eliminated with formation of a blue precipitate of hydrated cupric hydroxide, which retains by adsorption part of the sulphate radicle. It would appear that this adsorption of the sulphate radicle has been responsible for the statements of Pickering and others that a series of complex basic sulphates was formed when lime in excess of this ratio was added. This reaction is completed when the copper sulphate and lime are in the proportions (by weight) of approximately 4·4 : 1; consequently, in the bordeaux mixtures in use in which the proportions are more nearly in the proportion of 1 : 1 (by weight) or greater, it is evident the final product would consist of this copper hydroxide, calcium sulphate (formed as a result of combination between the copper sulphate and the calcium hydroxide), calcium hydroxide, and a small amount of calcium carbonate.

It is not unusual for authors to refer to different bordeaux sprays as being acid, neutral, or alkaline. That these are misleading terms is evidenced by the fact that an acid bordeaux would necessarily be one in which insufficient lime had been added to precipitate the copper sulphate completely (since this salt gives a slightly acid reaction when in solution in water), requiring proportions of copper sulphate to lime in excess of 6 : 1 (by weight); a neutral bordeaux could be prepared only when complete precipitation had taken place, requiring proportions of from 6 : 1 to 4·4 : 1; and an alkaline bordeaux when lime in any excess of this 4·4 : 1

proportion was used. It is evident, therefore, that bordeaux mixtures in commercial use are strongly alkaline, owing to the considerable excess of lime which is added beyond the quantity necessary to bring about the formation of cupric hydroxide. Consequently it would appear that tests recommended for the determination of acidity or neutrality are valueless unless applied to sprays based on these 6 : 1 to 4·4 : 1 proportions, which are not found in practice to-day.

A discussion on the preparation of bordeaux mixture is necessarily complicated, in that the chemical and physical properties of the mixture are affected by many factors, such as the type of lime used, proportions of materials, and the manner in which the constituents are combined. These factors are discussed in the following sections, since all have a direct bearing on the value of this spray as a fungicide.

Types of Bordeaux Mixtures.

The copper salt used in the preparation of bordeaux mixture is invariably in the form of the soluble copper sulphate; but the lime used may be in the form of a solution (lime water), as quicklime, or as commercial hydrated lime.

(1) Lime Water Bordeaux.—About forty-five years ago lime water bordeaux was used on a commercial scale to a limited extent, principally in Italy, but did not come into general use largely owing to the fact that the solubility of lime is so low that it is not easy to prepare a mixture (in the proportions by weight of 1–1) with a content greater than about 2 lb. of copper sulphate to 100 gallons of water. An increase in the copper content is possible by using the proportions of 4 : 1, but this produces a spray in which the available copper is high, and as a result injury would follow its application to other than dormant trees. Furthermore, the precipitate formed is dense and difficult to pass through the spray pump. For these reasons the use of lime water bordeaux is now confined to laboratory studies on the chemical and physical properties of different preparations, as it supplies a convenient means of securing a known quantity of lime in solution.

(2) Quicklime Bordeaux.—Until recently the lime used in making most bordeaux sprays was in the form of quicklime, a material prepared by burning limestone, which converts it from calcium carbonate ($CaCO_3$) to calcium oxide (CaO). Before it may be combined with copper sulphate quicklime is slaked with water, which converts it to hydrated lime (calcium hydroxide, $Ca(OH)_2$) leading to an evolution of heat and an increase in volume. When a quantity of water is added to the product resulting from slaking, so-called milk of lime is produced, which consists of a small amount of lime water (calcium hydroxide in solution), the bulk being particles of hydrated lime, together with a small amount of calcium carbonate, and impurities which may be present in the quicklime. When this is added to a solution of copper sulphate (or *vice versa*), the lime water combines with the former, and additional lime goes into solution, and this process continues until the whole of the copper sulphate has been precipitated. If the spray were prepared so that the proportions by weight of copper sulphate to lime were 4·4 : 1, the whole of the lime added would go into solution; but if lime is in excess of this proportion (as in most

bordeaux mixtures) the excess remains as particles of the hydrate in the spray, and in this form is deposited upon the tree.

The degree of purity and freshness of the quicklime materially affects the final product, for impurities in the form of sand, magnesium hydroxide, or calcium carbonate will affect directly the proportions, and consequently the final product, unless the lime taken is in excess of that required to bring about the production of copper hydroxide. In most commercial bordeaux mixtures the formulæ recommended are such that lime is present in considerable excess, which safeguards the orchardist against the use of quicklimes of other than very inferior quality. Nevertheless, as the proportions are directly affected by these impurities, it is advisable to use a good-quality quicklime, and to keep it in sealed containers, for exposure to the air leads to conversion to calcium carbonate, the solubility of which is so low (about 1 lb. being soluble in 10,000 gallons of water) that it is practically worthless for the preparation of this spray.

The proportions may be altered likewise by faulty slaking of the quicklime, for unless this is carried out satisfactorily "drowning" may result, the consequence of which is that a large proportion of the lime remains in lump form and as a result is discarded. To obviate this difficulty, the following procedure is recommended, which, although somewhat slower than the usual practice, will lead to the production of a more satisfactory product. Place a given quantity of quicklime in a wooden vessel, a convenient weight being 30 lb. Add one-third of its weight of water (thus for 30 lb. of quicklime take 1 gallon of water), and wait until the lime breaks down to form a fine powder. To this may then be added 30 gallons of water, which will produce a stock solution of milk of lime, each gallon (when stirred well) containing 1 lb. of lime.

(3) Hydrated Lime Bordeaux.—It has been indicated that the object of slaking quicklime is to produce hydrated lime. As Goodwin and Martin (1927) have shown, it is possible to avoid the labour of slaking by using as a lime source prepared hydrated lime. The type recommended is the commercial article which, if properly prepared, is in the form of a fine powder practically free from lumps and impurities, and containing a calcium hydroxide content of at least 90 per cent. The advantages of using the commerical product are that the necessity for slaking is avoided, with its consequent waste of time and material, as the orchardist has but to weigh out a given quantity, mix with water to form a thin paste, and add to the spray tank; and that the particles are in an extremely fine state of division, a factor which materially affects the physical qualities of the spray.

Hydrated lime should be stored in a dry place, since it is prone to cake if exposed to undue moisture, and be kept where possible in sealed containers, since on exposure to the air it reverts slowly to the form of carbonate. Reversion is slow, however, for we have found that a good-quality material contained but 10 per cent. of carbonate when stored for six months in open 4-gallon petrol-tins.

(4) "Instant" Bordeaux.—During the past three seasons Schneiderhan (1929, 1932) tested out in West Virginia an improved process for the preparation of bordeaux mixture, which still further simplifies the preparation of this valuable fungicide. In the preparation of this type of bordeaux, which he termed "instant" bordeaux, the same

ingredients are used, but with the differences that both lime and copper sulphate are in powdered form, the lime being the commercial hydrate discussed above, the copper sulphate being in the form of "snow," due to the crystals being powdered by crushing so as to resemble granulated sugar.

In preparing this spray the tank is one-quarter filled with water, the agitator is set running, and a given quantity of the powdered copper sulphate is either poured slowly into the tank, or placed upon the strainer covering the intake so that the incoming stream of water carries the particles into the tank. With the agitator still running, the tank is filled to the three-quarters mark (during this time, if in excess of two minutes, the copper sulphate will have become dissolved), and the requisite amount of lime is then added, after being mixed with water into a thin paste. The tank is then filled, the agitator being run meanwhile, and after a few minutes of continuous agitation the spray is ready to apply.

The advantages of such a process are obvious, since both time and labour are saved; the disadvantages are confined to the difficulty of securing the type of materials necessary.

Preparation of Bordeaux Mixture.

Methods of mixing the Ingredients.—Pickering (1907), Butler (1914), and others recorded that the physical properties of a bordeaux spray were affected by the methods employed in mixing the solutions of copper sulphate and lime, and played an important part in affecting its adhesiveness and therefore its ability to form an effective protective cover. There are no less than nine possible methods of mixing these ingredients—namely, by pouring—

(1) Concentrated copper solution into diluted lime solution.
(2) Concentrated copper solution into concentrated lime solution.
(3) Diluted copper solution into diluted lime solution.
(4) Diluted copper solution into concentrated lime solution.
(5) Equal dilutions of both simultaneously into a third vessel.
(6) Concentrated lime solution into diluted copper solution.
(7) Concentrated lime solution into concentrated copper solution.
(8) Diluted lime solution into diluted copper solution.
(9) Diluted lime solution into concentrated copper solution.

By using the rate of settling or voluminousness of the precipitate as units of measurement (rapid settlement or a precipitate of relatively small volume being considered as indicating an inferior product), these workers have attempted to determine the most efficient of the methods outlined. Pickering (1907) recommended that the spray be prepared by adding a solution of concentrated copper sulphate to the diluted lime (method No. 1); Butler (1914), and Holland, Dunbar, and Gilligan (1927) considered that the best results were secured when the diluted copper solution was added to the concentrated lime (No. 4); and Schneiderhan (1932), as we have seen, recommended the addition of the concentrated lime to the diluted copper sulphate (No. 6) in the preparation of "instant" bordeaux. Bedford and Pickering (1919) condemned the practice of pouring concentrated solutions simultaneously into a third vessel;

Butler (1914) stated that methods Nos. 1, 2, and 7 gave unsatisfactory results; and Holland, Dunbar, and Gilligan, (1927) considered poor results were secured by using method No. 9.

These differences of opinion (especially as there is little definite evidence showing that bordeaux mixtures prepared by many of the methods condemned are inferior as fungicides) suggest that physical properties as measured by the criteria employed may not be as significant as has been indicated. This opinion is strengthened by the statement of Martin (1932) to the effect that the excellent adhesive properties of bordeaux mixtures are due to the fact that the bordeaux precipitate is formed on the tree subsequent to the deposition thereon of the copper-lime precipitate, by the action primarily of the carbon dioxide of the atmosphere.

In our experiments we have secured excellent results with hydrated lime bordeaux mixtures prepared by adding the concentrated lime to the diluted copper sulphate solution (method No. 6). This is a convenient method, and one which enables the spray to be prepared with a minimum of time and labour, and has the added advantage that it may be used in the preparation of "instant" bordeaux without alteration of procedure.

Quality of the Materials.—As the quality of the spray is affected by the quality of the ingredients the orchardist should use the best materials procurable. Copper sulphate should be of a reputable brand, guaranteed to possess a copper sulphate content of 98 per cent. Quicklime should have a low magnesium content, and be reasonably free from earth and sand, since these impurities are apt to damage the linings of the sprayer cylinders, and rapidly wear the disks of the nozzles. A good quality hydrated lime should be practically free from impurities, such as sand or earth, should be fresh, and sold in containers which exclude air and moisture. The particles should be in an extremely fine state of division, a good-quality article being one in which 95 per cent. of the material will pass a 300-mesh sieve, or in which 90 per cent. will remain in suspension for upwards of three hours (Holland, Dunbar, and Gilligan, 1927).

Although it is possible to determine the quality of the materials from which bordeaux mixture is prepared, it is not possible by any known method to determine a factor by which the quality of the spray itself may be measured. Consequently, in the regulations applying to the Fungicides and Insecticides Act of 1927, it is possible to safeguard the orchardist only in so far as concerns the quality of the copper sulphate and lime. If he chooses quality products, and prepares his spray as recommended, and from the proportions specified, he will be assured of a satisfactory bordeaux spray.

Commercial Bordeaux Preparations.—Certain mixtures of lime and copper sulphate, in powder or paste form, have been placed upon this market as commercial bordeaux mixtures. In practice these have proved decidedly inferior and much more expensive than sprays prepared by the orchardist. In the United States, where several such are offered for sale, it is not unusual to attempt the assessment of their value by qualitative determinations of their copper content. Consideration will show that this unit of measurement is unreliable, since it is not the copper content alone that determines

the worth of a bordeaux, but the manner of its preparation, the proportions of copper sulphate to lime used, and the availability of the copper, as has been shown by Bedford and Pickering (1919). As no practical unit of measurement exists it is evident that use of these preparations is hazardous, consequently the safe attitude to adopt is to avoid products of this type.

Formulæ for Preparation of Bordeaux.—Since bordeaux sprays were first introduced into the Dominion it has been customary to indicate the quantities of ingredients in the form of a formula in in which materials are arranged in the order of copper sulphate, lime, and water. Thus to prepare the formula 5–4–50, 5 lb. of copper sulphate and 4 lb. of lime are added to 50 gallons of water. In Europe, however, quantities are expressed in percentages; for example, the same formula would be said to contain 1 per cent. copper sulphate and 0·8 per cent. lime. This is understandable if the formula given is arranged proportionately as 5 : 4 : 500, since 1 gallon of water weighs 10 lb. Although the percentage method is the more exact, the formula is the simpler method of expressing quantities, provided it is understood that the ingredients are not given in the same units of measurement.

Since the introduction of bordeaux mixture the formulæ used in its preparation have undergone numerous modifications. The first bordeaux sprays were based on formulæ of approximately 15–5–50, in which about three times as much copper sulphate as lime was used. Gradually these proportions were altered, leading to the introduction of the "equal" types of bordeaux, in which approximately the same quantities of copper sulphate and lime were used. An example in point is the 10–10–40 formula in general use some years ago. Then came the tendency to reduce the quantities of copper sulphate and lime in relation to the quantity of water, since it was found that the older preparations were unnecessarily concentrated. Sprays of to-day are based on these modified "equal" formulæ, an example being the well-known 4–4–40. Finally there has been a tendency, particularly in America, to decrease still further the copper sulphate, and increase materially the lime, with a view to enabling this spray to be used on apple-trees during the summer months. An example of such a type is the 2–10–40 bordeaux introduced into Nelson during the 1920–22 seasons.

In New Zealand the formulæ have gone through corresponding changes (the influence doubtless of recommendations being adapted from overseas publications of each current period), as is shown in the following examples: 3–3–50 (Hanlon, 1892); 6–4–22 (Kirk, 1896); 10–10–40, 4–4–40 (Kirk, 1898); 6–4–40 (Kirk, 1905); 8–6–40, 6–4–50, 4–5–50 (Dept. Agric. Bull. 57, 1918); 2–10–40 (spray used in Nelson 1920–22); 5–4–50, 3–4–50 (Cunningham, 1925).

Our experiences during the past three seasons have shown that the heavy applications of former years (10–10–40, 8–6–40) are unnecessary, and that excellent results have been secured with the 5–4–50 formula for winter applications and 3–4–50 for summer use. Consequently these are recommended until further experimental work under New Zealand conditions justify their modification. Details as to the times of application and diseases against which these sprays are applied will appear in the next article of this series.

(To be continued.)

INVESTIGATIONS IN PASTURE PRODUCTION.

III. EXPERIMENT AT MARTON TO COMPARE DIFFERENT FREQUENCIES OF APPLICATION OF SUPERPHOSPHATE ON YIELD AND CHEMICAL COMPOSITION OF PASTURE HERBAGE.

A. W. HUDSON, Crop Experimentalist, and B. W. DOAK; * Analytical Chemist, Plant Research Station, Department of Agriculture, Palmerston North.

As a full account of this investigation has just been published as Part 3 of Bulletin No. 31 of the Department of Scientific and Industrial Research, a summary embodying the main features is all that will be presented in this article.

The object of the investigation was to determine the effect on total production, and on production at various times of the year, of applying superphosphate as heavy dressings at long intervals, compared with lighter but more frequent dressings. The treatments were arranged so that each (with one exception) would receive 8 cwt. of superphosphate over a period of two years.

The treatments per acre under trial were as follows:—

(1) No phosphate.
(2) Superphosphate (44-46 per cent. tricalcic phosphate), 8 cwt. once in two years.
(3) Superphosphate, 4 cwt. once a year.
(4) Superphosphate, 2 cwt. twice a year.
(5) Superphosphate, 1⅓ cwt. three times a year.
(6) Superphosphate, 4 cwt. at commencement of experiment followed by 1⅓ cwt. as for Treatment 5.

Treatment 6 thus actually received 10⅔ cwt., compared with 8 cwt. for the other phosphate treatments over the two years. All plots received lime at the commencement of the trial and a dressing of potash each year to ensure lack of these not being limiting factors.

The pasture under trial was a good one of rye-grass and white clover. The technique adopted has been fully described in this *Journal* for August, 1931, page 88.

The present report covers the first two years of the trial from August, 1929, to August, 1931.

The heavy applications made at the commencement (Treatments 2, 3, and 6) gave the best results in the first year, as might be expected. Over the two-year period, however, the application made twice and three times a year (Treatments 4 and 5) gave much better results than the 8 cwt. applied at the beginning (Treatment 2), and slightly better results than Treatment 3, which received one application of 4 cwt. per annum. (Treatment 6, which received more super than any of the others, actually gave the highest production.)

Treatments receiving two or three applications a year gave a better production during the low-production period covered by the late summer, autumn, and winter period, confirming in this respect the results of an investigation reported on in the *Journal* for November, 1931, page 311. In addition to this, the applications made two or three times

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a year gave a greater proportion of their production during the low-production period than did " no phosphate " or Treatments 2 and 3. The result of this was that the difference, as a percentage of the total production, between the highest and lowest production periods was reduced.

In the second season the highest-yielding treatment produced 8,506 lb. of dry matter per acre, which is about equal to a 34-ton per acre crop of swedes.

Sixteen months from the commencement of the trial Treatments 4 and 5, which had then received 6 cwt. and 5⅓ cwt. of super respectively, had produced slightly more total herbage than Treatment 2, which had received 8 cwt. in one dressing.

During the whole of the second year the herbage from Treatments 1, 2, 3, and 6 was submitted to chemical analysis. The application three times a year in Treatment 6 kept the phosphate, lime, and protein content of the herbage at a more uniform level throughout the year than did less frequent applications. The beneficial effect in keeping the phosphate content up to a higher level during dry weather, when herbage is normally low in phosphate, is undoubtedly an important feature of summer dressings. All phosphate treatments increased the phosphate, lime, and protein content of the herbage over that of the " no phosphate " for the year as a whole.

The experiment is being continued, and the future results should be more informative than those for the first two years. The heavy applications made at the commencement had an initial advantage over those applied in smaller dressings more frequently. At the end of the two years, however, the more frequent applications had a decidedly favourable balance of phosphate, as was indicated by their higher production at this time, and they should show a greater superiority, at least over the dressing made once in two years, than was the case in the first two-year period.

DISCOLORATION IN CHEESE.

G. M. MOIR, Dairy Chemist, Wallaceville Laboratory.

AT the Wallaceville Laboratory the subject of discoloration in cheese has been investigated for some time by Mr. G. F. V. Morgan, Dairy Bacteriologist, with whom the writer has recently been associated. The investigations have conclusively shown that pink, bleached, and muddy or dark discoloration are due to the entry of air and mould growth from the rind subsequent to manufacture. Mould confined to the surface of the rind can scarcely be avoided and usually does little harm, but it can do serious damage whenever it penetrates the body of the cheese. This has been repeatedly observed to occur in two ways, (1) through badly sealed trier holes, (2) through cracked rinds.

To eliminate the first cause preventive measures were taken some time ago by using melted paraffin wax to seal trier holes made at the grading stores. If the same precautions were regularly adopted in the factories the unsightly appearance of mould within the cheese, and the associated losses, could be still further diminished.

The second means of admission of moulds to the body of the cheese —through cracked rinds—can be minimized by careful handling. By taking every care to make cheese with good rinds, and by further application of the steps already found useful to seal trier holes, complaints of losses due to discoloured cheese should become a thing of the past.

Conditions of Mould Growth.

Experiments have recently been carried out which have shown that in their early stages of growth moulds are able to produce acid conditions, especially if the supply of oxygen is very limited. At a later stage, if more oxygen is supplied, the moulds soon begin to produce alkali. These experiments represent a notable advance, for they show that mould, which usually in a mature stage produces the more alkaline conditions frequently found in discoloured portions of cheese, can, under special abnormal conditions, produce appreciable amounts of acid.

COD-LIVER OIL FOR BROODER CHICKS.

EXPERIMENT AT WALLACEVILLE POULTRY STATION.

H. A. Kitto, Overseer, Wallaceville Poultry Station.

For some considerable time past the use of cod-liver oil as a food for poultry has been advocated in various parts of the world. It is only recently, however, that its use has received much attention from poultry-keepers in New Zealand. As is commonly the case with most new things advocated for feeding poultry, there is a wide difference of opinion among those who have included this material in the ration for their fowls regarding its value as a food from an economic standpoint when fed to birds of any age. It is probable, however, that few, if any, poultry-keepers who have used it in this country had any control fowls with which results could be compared between birds fed with and those without the cod-liver oil. Therefore in the absence of reliable data the extent to which this material can be profitably included in a ration for poultry is somewhat problematical, so far as our present local experience with it is concerned, and probably such will continue to be the case until we have the results of further practical experience to guide us.

In an endeavour to gain some first-hand data in regard to feeding cod-liver oil to poultry, some investigational work was carried out at the Wallaceville Poultry Station during the past year. The first experiment commenced on 17th August, and terminated on 13th November last. In this experiment 162 chicks took part. These were taken direct from an incubator and placed under a canopy style of brooder, heated by means of electricity. The brooder and also the room in which it was installed were divided in the centre by light wooden frames covered with small-mesh wire netting. The 162 chicks were equally divided and placed on each side of the brooder, so that the conditions provided for each lot of chicks were similar in all respects. From the outset both lots of chicks received a similar food ration, excepting that one lot had cod-liver oil added to the mash mixture once a day.

This was given at the rate of ¼ oz. for the first ten days, and ½ oz. for the following thirty-two days, and from then onward to the termination of the test 1 oz. of oil was fed daily.

It has been claimed that the addition of cod-liver oil to the ration for young chicks will have the effect of promoting vigorous development, increased bodily weight, and a minimum death-rate; therefore the chief object aimed at in this experiment was to determine as far as possible to what degree, if any, the oil-fed birds would increase their weight, vigour, &c., as compared with the control birds which did not receive oil. Each lot of chicks was carefully weighed collectively before being placed under the brooder, and at weekly periods during the progress of the test. The accompanying table shows the results of the different weighings.

Both lots of chicks were practically of the same weight when placed under the brooder. Unfortunately, six deaths occurred during the test — two of the oil-fed birds and four of the controls. To a certain extent this detracted from the value of the experiment; nevertheless a study of the figures contained in the table gives sufficient indication that the cod-liver oil had little if any influence in increasing the weight of the chicks to which it was fed, while at no stage of the test was there any observable difference in general appearance between the two lots of chicks. This applied not only to the observations of those directly interested in the experiment, but to visitors as well. The feathers on the heads of the oil-fed birds were marked with indelible pencil, which naturally attracted the attention of many visitors, and inquiries were made regarding the purpose of the mark. Usually before satisfying inquirers on this point the question was asked as to which lot of chicks they considered looked the better. In some cases the oil-fed birds were selected, and in others the controls, which goes to show that there was nothing outstanding in the general appearance of the oil-fed birds.

Table showing Periodical Weighings of Chicks in Experiment.

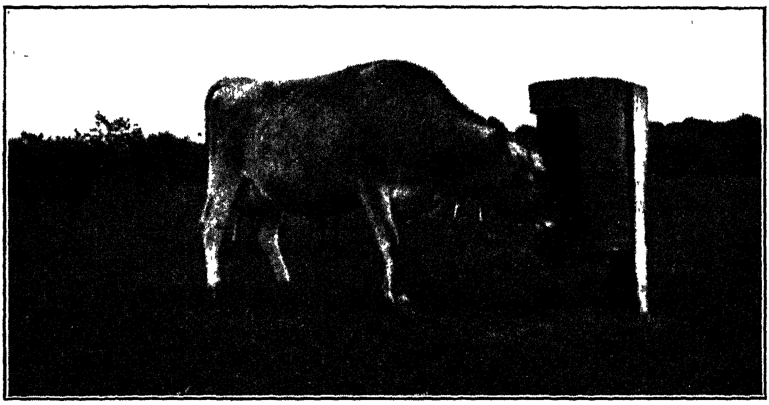
Date of Weighing.	Oil-fed Chicks.			Control Chicks.		
	Weight.		Number.	Weight.		Number.
	lb.	oz.		lb.	oz.	
August 17th	8	9¾	81	8	8¼	81
,, 24th	11	13½	80	11	14¼	80
,, 31st	25	2¼	79	25	6¾	79
September 7th	38	8¾	79	39	0	79
,, 14th	39	9½	79	39	7¼	79
,, 21st	49	12	79	51	13½	79
,, 28th	60	15	79	65	4	79
October 5th	73	8½	79	73	9¼	77
,, 12th	86	8	79	83	0	77
,, 19th	106	4	79	102	12	77
,, 26th	125	8	79	122	0	77
November 2nd	145	12	79	142	4	77
,, 9th	169	0	79	164	12	77

A similar experiment will be carried out during the forthcoming hatching and rearing season.

CATTLE-LICK CONTAINER FROM OLD MILK-CAN.

MR. H. R. Denize, Inspector of Stock, Hawera, forwards particulars of an economical cattle-lick container devised by Mr. R. A. Anstis, Normanby, and in use on his farm, as shown in the accompanying photograph. Directions for making and erecting are given as follows :—

Use an old 20-gallon milk-can. Cut out a piece from the side measuring 20 in. by 22 in., leaving about 6 in. at the bottom end of the can and about 3 in. at the lid end. Drill a ½-in. hole through the centre band round the can directly opposite the centre of the aperture. Fix the lid securely



in position. To erect, turn the can up-side-down, and bolt it to a substantial and sound post with a clearance of about 1 ft. from the ground, facing the can in such a direction that the prevailing winds will not blow rain into it. To prevent the can from swinging about on the bolt, either hollow out the face of the post or nail a batten down each side of the post close against the can. A thin layer of cement concrete on the top and in the lid will make the can rust-proof and rain-proof.

Dairy-cow Hygiene.—Apart from the sanitation of the milking-shed itself, improved hygienic handling of dairy cows is very desirable—in fact, more than ever necessary to-day when the production of clean milk is being so strongly advocated. Furthermore, the practice of cow hygiene materially tends to lessen the incidence of such diseases as mammitis, abortion, foul-foot, &c. The hygiene of the dairy cow may be said to begin with the yards. Dirty, muddy yards lead to the accumulation of dirt on the udders and legs of the cow before she enters the shed. Yards should be concreted, or at least metalled, so as to provide a surface readily cleaned. Strict attention should be paid to the cleansing of the teats and udder before milking. Accumulation of filth on the cows' tails is a source of milk-contamination. Leg-ropes need special mention ; the rope is handled by the milker immediately before he proceeds to milk, and is frequently septic. Stools, and the handles releasing the shed-doors should be washed daily. In dry dusty weather the flanks and quarters of the cow should be cleaned before milking begins. Cows with uterine discharge or retained afterbirth should not be allowed into the shed, but isolated and suitably treated.

SEASONAL NOTES.

THE FARM.

Breaking-up of Pasture.

A MOST important matter that many farmers will have occasion to consider at this time of the year is the amount and location of the grassland it is advisable to put under the plough during the coming season. This matter usually needs to be considered from several aspects. Firstly, it is necessary to take into account what area of special crops—such as mangels, swedes, turnips, and chou mœllier—should be grown to ensure adequate provision of feed for the critical periods when the feed available from grassland is likely to be below the current requirement of stock. Of some significance in this connection is the fact that generally the provision made for the critical seasons is inadequate—sometimes markedly inadequate—and that especially in dairying, but also in sheep-farming, there would frequently be more profitable returns were the plough more freely used as a step towards better feeding during those periods when the growth on pastures is commonly scant.

Secondly, the ploughing-down of many pastures is called for because of their inferior swards. In some cases such pastures may consist of plants generally inferior to those which the land is fitted to support advantageously when due regard is given to the possibility of reinforcing natural fertility by judicious top-dressing. For instance, pastures which are dominantly weeds, brown-top, or dogstail may be found occupying ground which could profitably support rye-grass, white clover, and cocksfoot, especially if given reasonable assistance in the form of phosphatic top-dressing and efficient grazing management. In other cases, because of the use of inferior types of seed, incorrectly reputed to be of perennial character, or because of the ravages of the grass-grub, pastures may consist of plants so few in number as to warrant ploughing as a first step towards replacement of the open swards with ones of greater density.

With some justification, based on past experience, farmers at times hesitate to plough up pastures which they believe are not of as high a standard as could reasonably be expected in the circumstances. Underlying such an attitude is usually a doubt as to whether it is possible to replace the present pastures by ones which will continue to be superior to them for a period long enough to make the venture a profitable one. The doubt which operates in such cases originates almost invariably in disappointing past experience, in which the use of inferior strains of pasture species led to rapid falling-off in production of relatively young pastures. All doubt of this nature is unjustified in the light of the present knowledge of strain differences in important pasture species, of which perennial rye-grass is of most current moment. We now know not only that at times newly sown pastures fell away in a disappointing manner but also why this occurred, and fortunately the knowledge of why it occurred is supplemented by the knowledge of how to avoid such regrettable falling-off.

In brief, it has been demonstrated that lines of seed commercially known as "perennial" rye-grass fell broadly into two main classes, (1) true perennial, (2) false perennial, which at times proves less persistent and less valuable than ordinary Italian rye-grass. This latter undesirable type was commonly used in the sowing of pastures which were desired to be of as permanent a character as possible. Even on land of relatively high fertility such inferior rye-grass incorrectly reputed to be of a perennial nature disappeared from the sward in a comparatively short time, thereby

making an opening for the entrance of inferior plant species, the ultimate result being that the young pasture tended quickly to descend to the low standard of the one which it replaced. The use of the true perennial type of rye-grass would obviate such falling-off in pastures.

The fact that the official system of seed certification assures a reliable supply of the desirable strains of pasture plants has within recent years intensified the case for the breaking-up of worn-out pastures, which at times have been retained mainly because of uncertainty, the real justification of which has now been largely removed. While strain differences are of paramount importance in the case of rye-grass, they are of considerable, even if not of equal, importance in the case of white clover and cocksfoot. The position is summed up in the fact that the possibility of using improved strains of pasture plants is a direct and weighty incentive to the replacement of somewhat inferior pastures by the best possible swards which will respond more profitably to good pasture-management, practices such as top-dressing, and efficient grazing management.

A third matter bearing on the breaking-up of pastures is the role of top-dressing. By top-dressing farmers have often been able to achieve such great results that they have inclined at times to rely on it overmuch. Certain pastures have been improved strikingly by top-dressing, and from this it has been deduced that all pastures could be similarly improved. This is not always so, but, even if it were, it does not necessarily follow that top-dressing is the most economical means of improving the composition of pastures. It is quite conceivable that the improvement which could be effected in a short time by breaking up and renewal would take so long to achieve by top-dressing as to make the breaking-up and resowing the more desirable method, despite the fact that it involves the greater immediate expense.

Further, it is overlooked at times that on certain swards top-dressing, even if it is as judiciously done as possible, can reasonably be expected to bring about only a very limited amount of improvement; if a sward is devoid of superior species such as rye-grass, white clover, and cocksfoot, the influence of top-dressing is necessarily limited to the inferior plants which are present, and is unlikely to bring about any marked changes in sward composition. In such cases the standard method of obtaining an improved sward is ploughing and reseeding.

In some instances this standard method, because of labour, cost, or other considerations, may not be practicable. In such cases it may be advisable to endeavour to bring about sward renovation by surface sowing of seed. It is well to keep in mind that surface sowing is associated with risks arising mainly from weather conditions, and is not always successful. Hence, if at all practicable, the sowing of pasture seeds on a ploughed and cultivated surface should be practised.

The position summed up is that during recent years the breaking-up of inferior pastures has not proceeded as fast as it profitably could have done. At times there has been too great a tendency to effect pasture improvement by slower and at times uncertain methods, such as top-dressing and surface sowing of seed. From the pasture viewpoint alone, on many farms, a greater amount of ploughing would be well justified, and, in addition, ploughing, resulting in greater amounts of supplementary crops, would tend to materially and profitably improve the feeding of our live-stock.

Pasture Top-dressing, &c.

Much useful top-dressing may be done in July and August, and at this stage it would probably be very advisable on the part of those whose top-dressing programme has as yet this year been restricted. The use of superphosphate at this season may generally be recommended. Farmers who are faced with the prospect of an acute shortage of feed during August and

September may well give consideration to the use in late July or August of sulphate of ammonia or analagous nitrogenous manures, which in such circumstances tend to be profitable as a means of securing additional early season feed. As a rule these nitrogenous manures should be accompanied by the use of superphosphate or other phosphates, unless phosphates were applied to the pastures at a date not far distant. In this connection the use of ammoniated superphosphate avoids the necessity of handling separately the nitrogenous and phosphatic materials. Pastures that are to be dressed at this season with nitrogenous material should preferably be well-drained ones containing rye-grass as a prominent constituent. In addition, prior to the application of the top-dressing, they should be eaten back so that all coarse dry herbage is removed as completely as possible, and generally they should be harrowed immediately before or after the fertilizer is applied.

Last month's notes relative to grassland work, including ensilage, are applicable in the main to the July-August operations on farms.

General Cropping Work.

Especially in the South Island, cultivation work should be pushed ahead with the utmost expedition whenever the soil is dry enough to allow of working it without doing harm. The speeding of the plough and other implements is specially desirable in the preparatory work for cereal crops, but it is similarly, even though not equally, advisable in preparation of such crops as lucerne, mangels, and potatoes. When old swards are being broken up for these crops it is often advisable to fit a skimming attachment to the plough, in order to effect a complete burial of the surface layer with its complement of weeds.

As already suggested, cultivation work for cereals should generally take precedence over all other team work. From experience it has become customary to sow the bulk of the spring wheat crop in August and early September. The sowing of oats should, as a rule, be proceeded with as soon as the wheat sowing has been effected. Black Skinless barley may often be sown advantageously in August.

In the spring sowing of cereals a greater amount of seed is usually used than in the autumn sowing. For example, a sowing of 2 bushels of Tuscan wheat is favoured in spring, in comparison with 1½ and 1¾ bushels per acre in autumn.

Autumn-sown cereals, if they are to be allowed to develop into a chaff or grain crop, should be given a final grazing about the end of August. However, if lodging of the crop is anticipated on account of the high fertility of the land, then the final feeding-off may well take place in September. Generally after the final feeding-off of cereals the crops may advantageously be tine-harrowed—this serves to loosen the trampled surface and to break up and scatter droppings. Feeding-off of cereals in the spring should be done by heavily stocking the area for a short period, and this preferably when the soil is as dry as possible. Harrowing of autumn-sown wheat, if it is somewhat thin, is often advantageous even if the crop has not been eaten off, for the harrowing tends to increase the amount of tillering, which thickens the crop.

Seed treatment for the control of disease is just as advisable in the case of spring-sown as it is in the case of autumn-sown cereals. Further, the seed of oats and barley calls for treatment just as does seed wheat. It is sometimes advanced as an excuse for not treating seed oats that the crop will not be harvested for grain. This excuse overlooks the fact that chaff from a smutted crop is of less value than chaff from a similar crop free from smut. The copper carbonate treatment is recommended for seed wheat, with the formalin treatment as an alternative. For oats and barley the formalin treatment is recommended. Details of both treatments may be obtained from local officers of the Fields Division.

Winter Feeding.

Every possible endeavour should be made to bring about the adequate feeding in July and August of dairy-cows and breeding-ewes. Because of the unusually marked shortage of feed this year it may prove advisable for some farmers to supplement their supplies of silage, hay, and roots by purchased feeds such as bran and meals.

If sheep which are to be fed silage have not consumed it previously, then the silage should be introduced into their winter rations before they have become markedly low in condition. Sometimes sheep start to eat silage only when they have been reduced to a hungry condition, and it is preferable to subject them to a period of hunger while they are still in relatively good condition. Two to three pounds a head daily of silage is a substantial contribution to a sheep's requirements, while 5 lb. a head daily suffices for complete maintenance.

Other aspects of crop production and crop utilization which are of importance at this season were discussed in last month's Farm Notes.

—*R. P. Connell, Field Division, Palmerston North.*

THE ORCHARD.

Spring Spraying of Stone Fruits.

WITH the commencement of the spraying season, it should be distinctly understood that no recommendations in these or any other notes can be effective unless the programme outlined is consistently and completely carried out to schedule. The strengths advocated and the times of application must be strictly adhered to, and the ingredients accurately weighed or measured with standard weights and measures. The guessing of weights and the use of tobacco tins for measuring have been costly to many growers. Neither can any programme be effective unless the applications are thorough. Once the spray plant is working the little extra time and material required to adequately cover every portion of every tree are a mere bagatelle compared with the results obtained. The average man at the nozzle does *not* give an effective cover to the trees, and it is astounding the amount that is left unsprayed by many who are looked upon as careful sprayers and who feel that they are doing the work well.

Leaf-curl, Die-back, Rust, Brown-rot, Shothole, Bladder Plum, &c.—With varieties of peaches and nectarines that are very subject to leaf-curl, with apricots that are susceptible to shothole, and in districts where the other diseases are troublesome, two applications of a fungicide are advisable prior to blossoming. The first should be applied at, or just prior to, the first movement shown of the terminal wood buds on the laterals, and the second when most of the wood buds are showing a definite move; some ten days before the first indication of "pink" in the most advanced blossom buds. If an autumn fungicide has been applied the first of these applications can be omitted. With the varieties less susceptible to curl and shothole, and in localities moderately free from the other diseases, one pre-blossom application will be found sufficient—namely, at early movement of wood buds.

The sprays recommended are bordeaux mixture 5–4–50 (bluestone 5 lb., quicklime 4 lb., water 50 gallons), or burgundy mixture 5–5–50 (bluestone 5 lb., washing soda 5 lb., water 50 gallons). A number of growers who last season tried bordeaux made with hydrated lime had satisfactory results. The strength used was 3½–2–50 (bluestone 3½ lb., hydrated lime 2 lb., water 50 gallons).

Lime-sulphur, while effective for some of the above-mentioned diseases, has not proved itself satisfactory for the control of leaf-curl, neither has

it yet proved itself an effective controllant of shothole of the apricot. Those who desire to use lime-sulphur should consult the table of dilutions compiled by Dr. G. H. Cunningham which appeared on page 265 of the April issue of this *Journal.*

The Orchardist's Nursery.

In the April issue of the *Journal* suggestions were made for the establishment of an orchardist's nursery. Where stocks have been procured they should be planted in the nursery in rows 2 ft. apart and 1 ft. between the trees in the row. This should be done as soon as the soil is in good condition and the weather permits. The roots should be carefully pruned, cutting off any that are broken or damaged, and cutting back the top to, say, 1 ft. from ground-level. Care must be taken to avoid any possibility of drying out before planting, otherwise commencement of growth will be delayed. For the same reason planting should be done firmly, treading the soil well down on the roots, and leaving it loose on the very top. Most of these stocks should be ready for budding next autumn.

The soil where cuttings were planted in the autumn requires to be kept stirred and free from weeds by light hoeing and hand weeding; deep working must be avoided, as injury may result to the roots.

Stones or pits of plums, peaches, and apricots will require attention as soon as the ground is in fit condition and has been worked up into a fine tilth. Plum stones should be sown in drills 12 in. to 18 in. apart and about 3 in. deep, after which the ground is well firmed by treading as is done with peas and beans. It is unlikely that the resultant trees will be ready for budding next autumn, they can therefore be sown fairly closely in the drills, for they will be raised and transplanted into proper nursery rows next season.

Many of the peach and nectarine pits sown this spring will be large enough to bud next summer, consequently they are treated in a somewhat different manner to plums. The pits are usually sown shallow and close together in beds or drills in well-worked soil in which for preference a fair amount of sand has been incorporated. As soon as they have sprouted through the ground and are large enough to handle they can be carefully transplanted with a garden trowel into nursery rows 1 ft. apart between the plants and 2 ft. between the rows. Peach pits may also be sown thickly in the nursery row about 3 in. deep and thinned out to 1 ft. apart when large enough to handle, the thinnings again being transplanted into other nursery rows. The former method is preferable. The young seedlings should be transplanted to the same depth as they were in the seed-bed or drill.

The young apricot seedling is slower growing than the peach and in most districts there will be very few ready for budding next autumn; the stones, therefore, may be successfully treated either like the plum or the peach.

Trees that were budded last autumn should be looked over and all growths below the bud removed. Trees on which the buds have taken should be cut back to 3 in. or 4 in. above the bud, and the stub later used for tying to the young growth to prevent wind damage. Those which have been missed can be grafted this spring so as to save a season.

Planting.

Considerable care and attention should be given to planting, as it is anticipated that a tree once planted will be in the ground for many years. In new plantings see that the trees are symmetrically planted, and where replacements are being made that they are in line with other trees in all directions. Trees should be planted as soon as the ground is free from frost, is dry enough, and is in good tilth. Plant to the same

depth as they were in the nursery, as indicated by the soil mark. Lay out the ground first, see that the hole is large enough, that the soil immediately beneath and around the roots is good and in good condition and work a little blood and bone and superphosphate into the soil at the bottom of the hole, but not so that the roots are directly touching the fertilizer. Trim the roots, cutting back any broken or damaged pieces. Place the tree upright in the hole, partly fill with good soil, shake the tree slightly so as to fill in the hollows around the roots, tread firmly, fill the hole almost to the top, tread again, and complete by filling with soil left loose and standing a little above the ground-level.

If the tree is a yearling whip, prune the tree back to a little below knee high; if branched cut away everything except three well-placed branches, and shorten these to three or four buds. If the branches are too weakly, are badly placed, or are too high, cut off all branches and head back to the right level.

Miscellaneous.

Pruning should now be pushed on with the utmost vigour, so that it may be completed before movement commences and to enable growers to proceed with other important work. Prunings should be collected and burned, and large cuts covered with coal tar or paint.

Orchardists who have not yet applied their fertilizers should do so at once. Those intending to give the trees sulphate of ammonia or nitrate of soda should apply the former about green-tip and the latter in the pink stage.

Old trees that were worked over last season should have much of the wood which has come away on the stock removed, and the large cuts sawn carefully at a slant to the graft and painted or tarred. Where there have been misses, appropriately placed young shoots should be left untouched now and whip-grafted in the spring. Those that were budded last autumn should be headed back to within 3 in. or 4 in. of the bud; the young shoots can later be tied to the stub to protect it from wind.

The main working of the ground will be the ploughing in of the cover-crop and weeds. This is better done as soon as possible, so as to allow the material to rot before the dry weather sets in; otherwise the soil will remain puffy and full of hollows underneath, which will cause it to dry out still further.

—*W. R. L. Williams, Orchard Instructor, Alexandra.*

Citrus Culture.

Where new plantations are being established, or the present ones extended, it is assumed that every effort has been made to bring the soil into a suitable state for the reception of the trees. Planting of any kind is not advisable unless all preliminary work has been carried out. Citrus trees will thrive upon quite a large range of soils, provided the land has been treated in a proper manner. Thorough drainage is essential in all soils and should receive every consideration. Plenty of shelter should also be provided, and if this is not already well established the citrus trees will suffer from being exposed to the strong winds. The ideal for all citrus trees is a moderately rich friable soil having a plentiful supply of organic matter. A northerly aspect is preferable, and a situation that receives an abundance of sunshine and is well sheltered from the west and south-west winds.

If everything is in readiness the trees can be planted out at any time from now on until the end of September, but on no account should planting be done if the soil is very wet. Before planting, any damaged roots should be cut away, and as the tree is placed in the hole already provided some fine soil should be placed around it and trodden firmly. It has ne

is very poor practice to hurry over the planting of any trees. A little extra time and care bestowed at this period is well worth while. After the first soil has been well firmed it is advisable to make an application of some suitable fertilizer, such as blood and bone, or superphosphate, around the outer edge of the hole. About 1 lb. should be sufficient. By distributing it around the outside of the hole it will encourage the young rootlets to work outwards in search of food, and development will take place. The final filling should then be carried out and the top 2 in. of soil left quite loose.

Young well-grown healthy trees planted out under the conditions briefly outlined should come away quickly and establish themselves in such a way as to become in quite a short period profitable commercial plantations. On the other hand, if even some of these conditions are lacking, the trees may be a disappointment and bring discouragement to the grower.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Hatching and Rearing.

AUGUST and September are generally regarded as being the best months of the year for hatching out chickens for the renewal of stock, and therefore every effort should be made to secure the required number of young birds before the end of September, or early in October at the latest. Chickens brought out at a later period seldom prove satisfactory. Indeed, at the current prices for foodstuffs, late-hatched stock may easily show a loss for the season instead of a profit. Apart from laying undersized eggs, the bulk of which are produced during the cheap season, the birds are always more prone to disease and parasitic infestation than those brought out at the right time. Obviously the greater the number of late-hatched birds on the plant, the greater the drain on profits.

Where the natural mothers are depended upon, the question of securing broody hens at this period of the year is frequently found to be a difficult one, especially on plants where none but heavy-producing stock are kept, for as the egg type advances the broody tendency weakens, so that the more profitable the stock from an egg-laying viewpoint the greater the difficulty in obtaining broody hens. The White Leghorn is a case in point, for with the best egg-producing types of this breed the broody propensity has almost disappeared. Even with the noted laying strains of the heavier breeds, such as the Black Orpington, the tendency to broodiness is weakening, and even where in this class of stock broodies may be depended upon, they invariably do not become broody until too late for the hatching of winter layers.

Where the plant is on a small scale, and an incubator is not used, the difficulty is a vital one. There are three alternatives: (1) To keep some poor-laying types of the heavier breeds; (2) to secure day-old chicks and rear them by artificial means; (3) to secure, if possible, eight- to ten-weeks-old pullets. This trade is now being catered for by several specialist breeders, and also by the Department's Wallaceville Poultry Station. In view of the moderate prices at which the young birds are quoted, and having regard to the fact that they are reared beyond the critical stages of their life, and to the reduction of the loss entailed in rearing cockerels to an age when the sexes can be determined, the question of stocking up the plant with young pullets should specially appeal to the farmer and other side-line poultry-keepers.

Brooder Hints.

While the quality and constitution of the breeding-stock determines to a large extent the quality of chicks produced, the production of satisfactory progeny depends on something more than parentage. Chicken-rearing by artificial means is a business of many small details, and if these are not observed in every respect the best chickens ever hatched will fail to thrive or develop into profitable stock.

If success is to be achieved, and the mortality reduced to a minimum, the chicks must be well and carefully handled from the day they leave the shell, and right through all stages of their development. Having a batch of well-hatched good strong chicks, it is of vital importance that the young birds are well dried off before being removed from the incubator to the brooder. To aid this the moisture pans should be removed from the incubator and the ventilators opened wide. As a further means to this end the door of the incubator may be opened, say, about ½ in., just previous to transferring the little birds to the brooder. If chicks are removed from the incubator before they are thoroughly dry they become highly susceptible to chill, and this must be avoided, or mortality is almost sure to follow.

When the chicks are placed under the brooder the next important detail is to provide them with a more or less uniform degree of temperature, but the brooder should be so arranged that the chicks can secure a variation of warmth. In this way they are given an opportunity to move away from the heat when it is excessive, which frequently happens on a hot night. The behaviour of the chicks at night is the best guide as to whether they are comfortable or not. If the chicks are spread out it may be taken for granted that the heat being maintained is correct, but should they appear to be huddling it is an indication that more heat is required. Generally speaking, if given the opportunity, and provided they are not overcrowded, they will secure the degree of warmth that instinct demands.

Where brooders of the canopy type are used, and normal conditions prevail, the chicks should be encouraged to settle down at night around the outside edge of the brooder. In this way the chicks are afforded an opportunity of moving to and from the main source of heat and securing the desired degree of temperature. Even with this class of brooder the chicks will sometimes crowd into corners of the house. The cause of this behaviour is usually put down to excessive heat surrounding the brooder. Generally, however, it is due to a ground draught. Plenty of fresh air is an essential requirement for chickens of any age, but, above all things, it must be provided without draught. If there is a draught from any particular quarter, the chicks will gradually move away from it until the corner is reached, indicating that they prefer to leave the chief source of heat, so essential for their welfare, rather than remain in a draught. If this trouble is to be prevented a draught-break must be arranged surrounding the brooder. Pieces of thin-gauge sheet tin about 15 in. high placed on the floor of the brooder-house will serve the purpose of checking draught, or a less expensive arrangement can be made from cut down petrol-tins joined together with pieces of thin wire.

Chickens should be carefully watched at sunset. It frequently happens that they will settle down on a spot where the sun has last shone on the floor of the brooder-house instead of going under the brooder. Where windows are used in the wall of a brooder house this habit will be checked by white-washing the windows when the chickens are young, or by placing curtains over the open space at the front of the house some time before sunset. In short, every care should be taken to prevent the chicks from huddling, which has the effect of making them susceptible to chill. Once they become affected in this way it is next to useless trying to doctor them; they usually

die in spite of anything that is done for them, and very often it pays to destroy them at the outset. It is safe to assume that more chickens die owing to chills, or fail to reach a proper stage of development through their evil effects, than from all other causes put together. If chickens receive a chill it usually takes about three days before the injurious effects manifest themselves, the most common symptoms being a general tendency to huddling, a distressed chirp, excessive thirst, droopy wings, and no inclination to leave the brooder or to eat. Then follows bowel trouble, and as a result of the huddling the delicate legs become spread, to be followed by an unsteady gait in the walk, and a general unthrifty appearance.

The common causes of chill are irregular temperatures in the brooder-box, overheating, and insufficient ventilation. Removing the chicks too soon from the incubator to the brooder before they are dry, and giving them too much freedom for the first few days, are also causes of chill. Prevention is the only way of dealing with this trouble. The brooder should be so constructed and attended to that extremes of heat and cold may be prevented, at the same time never allowing stuffiness or draughts to exist. More chickens should not be put in the brooder than it is capable of accommodating to the best advantage. Overcrowding is simply courting disaster.

Strict attention to cleanliness is another important matter which must not be overlooked. If the quarters are allowed to become foul and filthy the presence of parasites, lice, mites, and intestinal worm infestation is encouraged, and disease germs also. Before a new hatch of chicks is placed in the brooder the latter should be well cleaned and disinfected.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

First Spring Inspection.

WHENEVER the temperature will allow, advantage may be taken of fine spring days to give the colonies their first inspection of the season. It is highly important that this work should be undertaken early in August, and not postponed until brood-rearing has commenced in earnest. By this time small patches of brood will be found, and under favourable conditions the quantity will rapidly increase, but just in proportion to the amount of food available so will brood-rearing proceed. On no account should the examination be postponed indefinitely if it can be avoided, or in all probability losses will be recorded through starvation. During the dormant season the drain on the stores is small, but once the activities of the hive commence no effort should be spared to see that each individual colony has sufficient food to meet current demands. Colonies containing at this season 15 lb. to 20 lb. of honey may be left undisturbed for some weeks, but failing this amount preparation should be made for feeding.

Supers.—In order to facilitate brood-rearing, supers left on during the winter months may be removed and the bees confined to the brood-chamber. In cases where bees are found in the super, remove the deserted brood-combs and place the super containing the bees on the bottom-board. Make all the hives snug, and provide each with one or two extra mats. These will help to conserve the heat of the hive.

Queen-right Colonies.—As indicated, an important matter in connection with the first examination of colonies is to note the extent of brood-rearing in progress. This will largely determine whether the colony has a laying-queen. Do not hastily conclude that a colony is queenless if brood is not visible, as much depends on the locality and weather conditions preceding

the examination. If the colony is strong and normal the question of queenlessness may be postponed until a later date. Make a note of each hive and its condition for future reference.

Apiary Records.

At every examination the beekeeper should make a record of the condition of his hives with regard to stores, brood, health, and fertility of queen. These records are invaluable, and enable one to proceed about the work systematically. Where time and labour are considerations, notes made at the time of inspection will save confusion and endless trouble. A pencil note on the inside of the cover, or on a piece of section placed under the roof, is handy for reference if by any chance the notebook be mislaid.

Preparations for the New Season.

The beekeeper should as far as possible utilize his spare time in making preparations for the coming season. Generally there is a good deal of work which can be undertaken now. Push on with hive and frame making if increase has been decided upon, and with the overhauling of any faulty supers, roofs, and bottom-boards. Usually when the bees are absorbing the greater part of the beekeeper's attention he will find very little time to attend to the mechanical part of the work. Do not postpone ordering supplies. Beekeepers who are not skilled with tools will find it more profitable to purchase their hives from the manufacturers. The machine-made hives can be depended upon, as they have been brought to a high standard of perfection.

When purchasing new supplies aim at uniformity. Do not be tempted to purchase job lines of bee material because dealers have represented the lines to be cheap. Standardize your hives, and endeavour each season as far as possible to dispense with badly fitting supers, &c. Nothing is more tantalizing than to find that supers will not fit the bottom-boards, or that roofs are an inch or so too long. One cannot afford to neglect the working-plant. Good standard hives are among the essentials that lead to profitable management.

Frame Making and Wiring.

A great deal of time must necessarily be spent performing this very important part of the work. The assembling of brood-frames and extracting-frames should receive every consideration. There are many plans for curtailing the labour involved, but, whatever method is adopted, strict attention must be given to proper nailing. Neglect to secure frames properly will lead to endless worry when the frames are in use. In districts where the bees gather propolis in large quantities too great caution cannot be exercised in nailing. It is not sufficient to drive a nail down through the top bar into the end bar. Too often the top bar will come away and leave the end bars jammed by the pressure of the other frames and adhering propolis. To guard against this trouble, the end bars should be nailed to the top bar by driving two nails through the end bars parallel with and into the top bar. This will secure the frame and prevent it from breaking when in use. On no account dispense with wiring the frames if the combs are to be extracted. Good wiring will enable the beekeeper to handle his combs freely, and even on very hot days there is no risk of their falling from the frames, as is the case when wiring is not adopted. When using full sheets of foundation it is a distinct advantage to employ wire. This holds the foundation in position, and good straight combs are produced. See that the wires are tight and securely fastened. A time-saving method is to cut the wire into lengths of about 60 in., and bind in the centre; the strands can then be pulled out as required.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Tomato Crops, Hotbeds, and Seed-boxes.

THE tomato crop under glass is usually planted out, in the middle districts, towards the end of August. It is important to plant deeply and firmly. While such houses should be aired well at every opportunity in fine warm weather, the ventilators should be closed early in the afternoon before the temperatures commence to fall; 55° to 65° F. is a suitable range. If the temperature is allowed to rise much above this maximum it makes the plants tender and more liable to injury during a cold snap.

Fresh stable manure should be accumulated for hotbeds and carefully prepared. When it is in a suitable condition a foot or two in the bottom of a glass frame will provide sufficient heat, in moderately warm districts, on which to place seed-boxes for raising tomato and other half-hardy plants for planting outside. In cold districts the usual hotbed, 2 ft. to 3 ft. in height, will be required, and the frame placed on top.

In large establishments the sterilization of the soil for seed-boxes has become a usual practice and much difficulty is avoided in this manner; but fungus troubles sometimes do occur, and in such cases a solution of permanganate of potash is an easy and convenient remedy. A stock solution may be made up, and a small quantity, diluted as required to a pink colour, may be sprayed on the plants from time to time, or they may be watered from a can with a fine rose. The permanganate may be used up to a strength of 1 oz. to 2 oz. of crystals to 4 gallons of water.

Small Fruits.

Strawberries and other small fruits should be given a dressing of such fertilizers as may be required, and shallow cultivations given in bright weather, when the land is dry enough, to destroy weeds. Bordeaux spraying at intervals of two or three weeks will be necessary in most cases to control fungus disease, especially the troublesome leaf-spots of different kinds which are very commonly found in these crops.

Vegetable Crops.

As rising temperatures in spring encourage the growth of weeds as well as crops, the former should be eliminated from the competition before they gain any size. This is best done in bright windy weather, and every opportunity of the kind should be taken. This operation also increases fertility and affords a suitable occasion for working in such dressings of fertilizers as may be required. Not only should growing crops be given this treatment, but it is also an excellent method of completing the preparation of fallow land for planting or sowing.

Spring cabbage, cauliflower, and salad plants generally that have been planted out and are now well established will receive benefit from a dressing of sulphate of ammonia at the rate of 1 oz. to the square yard, repeating the dressing two or three weeks later. Manure also established crops of asparagus and rhubarb; they both have healthy appetites and respond to generous feeding.

Crops of parsnips left in the ground over winter should now be lifted, or a second growth will spoil the flavour. If they are stored in dark, cool, humid conditions they will remain useful for the maximum period. Late-sown carrots should also be lifted so as to avoid splitting.

Towards the end of August in most districts cucumbers may be planted out in heated glasshouses suitable for the purpose. Set the plants deeply and not too firmly in mounds or ridges composed of two parts of good fibrous loam mixed with one part of decomposed stable manure, and a 5 in. pot of

bonedust to every barrow-load of the compost. Let the leader growth run to the top wire before stopping, and stop the lateral growth at the first point beyond the young fruit. When the temperature rises to 90° F. ventilation should be given. As the white rootlets push through the surface of the soil a top-dressing of the above-mentioned compost should be made.

The main crop of parsnips should now be sown, as they require a long season of growth; also melons and cucumbers under glass for planting outside later. Sow also, outside, early carrots, turnip-rooted beet, broad beans, main-crop cabbage and cauliflower, lettuce, early peas, parsley, spinach, and turnips. Sow thinly, and so reduce the work of thinning the young plants later. An amount of 1 oz. or 2 oz. of superphosphate per square yard before sowing, and a light dressing of nitrate of soda after thinning, will suit most of these crops.

Where it is intended to plant out permanent beds of asparagus and rhubarb this should be done now if the land is rich, clean, and deeply cultivated. Without this preparation it is best to defer the planting for another season. For asparagus plantings good selected one-year-old plants are best. They should be set deeply 18 in. to 24 in. apart, with 4 ft. between the rows, when planting large areas. For commercial cropping a moist, sandy, well-drained loam is required. Where small areas are being dealt with the best spacing generally is 18 in. between plants, and between the rows 18 in. and 4 ft. alternatively, thus making beds about 3 ft. wide with alleys between. Early potatoes and artichokes may also be planted.

The Homestead Garden.

Where new lawns are to be sown during the springtime the work is best done during the month of August in most districts. The surface should at least be smooth; in most cases it will need to be carefully graded, for the appearance of a lawn depends very much on doing this well. The level and fall of the surface of the land must be carefully adjusted to suit the position if the lawn is to be quite successful. This demands a great deal of consideration and labour, but once it is accomplished the result is permanent, and the lawn will always be a dominant feature in the garden.

Another important fact at the present time is that the end of the planting season—the time for planting trees and shrubs—is reached with the end of August. It may be continued for a while in districts with a good rainfall, but generally it can only be prolonged at some risk of incurring losses. To avoid this, planting should be completed as soon as possible when the land is sufficiently dry.

In the warmer districts roses should now be pruned. This consists chiefly in thinning out the growth and cutting back what is allowed to remain, so as to admit light and air, also to encourage vigorous growth. As the plants flower on the new wood, this is necessary if good blooms are to be obtained. Pruning may be carried to excess, but more commonly one finds the plants crowded with weak wood and flowers that are consequently not so attractive as they might be. With experience, the art of developing an even well-balanced tree is acquired.

—*W. C. Hyde, Horticulturist, Wellington.*

Lloyd George Raspberry.—Mr. J. D. Kennedy, Orchard Instructor, Auckland, reports: "The Lloyd George evergreen variety of raspberry has recently come under notice. Although raspberries do not usually thrive in the Auckland District, this variety of cane appears to be doing fairly well. It is a fairly strong grower, and has an abundance of well-developed buds and strong foliage, and at present shows every indication of becoming a success. Moreover, so far it has been quite immune from attack of the bud weevil, which is so destructive in raspberry plantations."

CERTIFICATION OF SEED POTATOES.

CROPS PASSED TUBER INSPECTION TO 30TH JUNE, 1932.

FOLLOWING is a list of growers whose crops have been subject to and have passed the tuber inspection in connection with the system of Government certification of seed potatoes conducted by the Department of Agriculture. The list comprises those crops passed up to 30th June. Further lists will be published later.

In the June *Journal* was published a list of growers who had received provisional certificates. The acreage, cropping-power, and percentages of foreign varieties present were given in that list, to which intending purchasers should refer.

Aucklander Short-top (N.Z. Sutton's Supreme).

Oakley, W., R.M.D., Halkett.
McPhail, W. A., Mitcham, via Rakaia.
Eder, W., R.M.D., Sefton.
Martin, W. E., R.M.D., Kaiapoi.
Cross, H. E., Sandy Knolls.
Heron, F., R M.D., Rangiora.
Warren, J., 149 Russley Road, Fendalton.
Carroll, A. D., R.M.D., Southbridge.
Jellie, J., Russley Road, Fendalton. (Line B.)
Petrie, J., jun., Swannanoa. (Line A.)
Sloan, Mrs. M., Lakeside.

Dakota.

McPhail, W. A., Mitcham, via Rakaia.
Burrowes, J., Mitcham, via Rakaia.

Aucklander Tall-top.

Frost, C. H., P.O., Balcairn.

Up-to-date.

Walker, C. E., R.M.D., West Melton.

Epicure.

McLachlan, G., R M.D., Southbridge.

Majestic.

Robinson, R. G., Box 4, Papanui. (Line A.)

Early Rose.

Weaver, J., R.M.D., Te Pirita.

Robin Adair

Robinson. R. G., Box 4, Papanui.
Brown, A. F., 92 Woolridge Road, Harewood.

Field Marshal.

Robinson, R. G., Box 4, Papanui.

Great Scot.

Robinson, R. G , Box 4, Papanui.

Early Regent Bolter.

Oakley, W., R.M.D., Halkett.

Arran Banner.

McNae, F., R M.D., Courtenay.

—*Fields Division.*

Orchard Pest declared.—The insect *Cydia* (*Carpocapsa*) *salitans*, popularly known as the Mexican jumping bean, has been declared a disease under the Orchard and Garden Diseases Act, and any importations of fruit or plants found to be infested with it are now liable to be destroyed at port of arrival in New Zealand.

Crimson Cox's Orange Apple.—Mr. J. H. Thorp, Orchard Instructor, Nelson, reports as follows: "Six small trees of this variety were received from England and planted at Nelson for testing in March, 1930. During the past season a small number of fruits were borne on the trees, some of which were picked and forwarded to Wellington at three different dates, covering a period of four weeks, coinciding with the picking of the ordinary Cox's Orange. The maturing period appears to be the same as local Cox's, and the tree and fruit have similar characteristics. The fruit, though carrying more suffused colour than the Cox's Orange, cannot be said to be exactly crimson, the redness being of a dull nature. As the fruit ripens the apple takes on a very yellow appearance, which, mingling with the red, gives rather a pleasing appearance. The flavour and texture do not appear to be quite equal to the Cox's, but this may improve with age of tree. Until this variety is further studied it is not advisable to recommend growers to take any action regarding its propagation."

WEATHER RECORDS: JUNE, 1932.

Dominion Meteorological Office.

THE reports received from different districts regarding the weather in June vary markedly according to whether or not they were exposed to the westerly winds which prevailed during the latter half of the month. Temperatures were actually below normal everywhere except in the southern half of the South Island, but in the Poverty Bay and Hawke's Bay districts, in Marlborough, North Canterbury, and parts of the interior of South Canterbury and Otago, the dry, sunny weather and absence of wind gave an impression of mildness. On the other hand, in the central and western portions of the North Island a series of severe frosts in the first half of the month was followed by a period of dull, wet, and boisterous weather. On the west coast of the South Island, though rainfall was somewhat above normal, conditions were rather better. Similarly, in Southland the weather was very dull and the rain much above the average, but the mean temperature was about normal for June, and there were no severe cold snaps or heavy snowfalls.

Rainfall was above normal in the western districts of both Islands and also in Southland. In the latter district and in the South Taranaki Bight the excesses were heavy. Much the greater part of the rest of the country had less than half the average for June.

Temperature.—As already intimated, mean temperatures were for the most part below normal. The departures were, however, seldom large, and over the southern half of the South Island the normal was exceeded slightly. Several falls of snow occurred on the high levels and the ranges now have a thick coating. In the low country there were no falls of any importance. Frosts were very numerous and frequently severe. The interior of the North Island, especially the Waikato district, experienced unusually heavy frosts in the first half of the month

Sunshine.—In Taranaki and Western Wellington, and in the southern half of the South Island, less than the average sunshine was recorded. At Invercargill the total duration was only 52·5 hours. Elsewhere, the totals were considerably above the June average.

Wind.—Westerly and south-westerly winds prevailed, especially during the latter half of the month. Above Foveaux Strait, and in Taranaki and the South Taranaki Bight, they were frequently boisterous.

Thunderstorms were unusually frequent and severe, particularly in districts with a westerly aspect.

Pressure Systems.—The first important storm occurred between the 4th and the 7th. This was a cyclonic depression which developed in the Tasman Sea, the centre crossing Otago on the 5th. Rain was almost general, and some severe thunderstorms were reported. On this same night there were extensive snowfalls on the ranges of both Islands.

The period from the 15th to the 28th was very disturbed. A series of depressions passed, the majority being of the westerly type. Showers or heavy rain were experienced every day in western and far southern districts. Thunder and hail storms were also of frequent occurrence. The Manawatu and neighbouring rivers were in flood for several days. Between the 16th and 18th some of the Southland rivers also were flooded. The heaviest and most widespread rain occurred on the 16th and 17th, when a cyclone again crossed Otago. Small tornadoes were experienced respectively at Whakatane on the night of the 16th and at Marton on the evening of the 25th. Eastern districts did not fare badly during the greater part of this time, but on the 28th a strong southerly set in and a bitterly cold day was experienced throughout the country. Precipitation was almost general. Snow fell on the high levels of both Islands, and

reached the low levels, but only in small quantities, in eastern and southern parts of the South Island. During the period here referred to barometers remained unusually low. On the 17th many places recorded pressures below 29 inches. From the 29th the weather began to improve.

RAINFALL FOR JUNE, 1932, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	3·14	13	0·90	6·82
Russell	4·24	14	1·32	6·66
Whangarei	3·74	15	0·70	6·67
Auckland	4·07	19	0·70	4·95
Hamilton	6·57	18	1·62	5·06
Rotorua	5·23	14	1·75	5·23
Kawhia	..	..	..	5·63
New Plymouth	6·16	18	1·08	5·98
Riversdale, Inglewood	9·32	19	1·56	10·29
Whangamomona	9·95	17	1·88	7·81
Eltham	6·12	15	2·25	5·71
Tairua	5·12	14	1·70	7·07
Tauranga	4·95	14	1·44	5·42
Maraehako Station, Opotiki	4·37	12	1·54	5·74
Gisborne	1·09	8	0·81	4·97
Taupo	6·21	15	1·82	4·50
Napier	0·45	7	0·23	3·51
Hastings	0·72	8	0·30	3·18
Taihape	4·29	21	0·54	3·43
Masterton	2·69	17	0·55	3·71
Patea	5·25	17	0·78	4·20
Wanganui	4·72	17	1·39	3·33
Foxton	4·62	13	1·12	3·28
Wellington	2·18	14	0·58	4·19
South Island.				
Westport	11·48	18	1·26	8·85
Greymouth	9·15	18	1·00	8·74
Hokitika	10·25	18	1·32	9·30
Ross	9·28	15	1·45	8·70
Arthur's Pass	10·34	11	2·80	10·54
Okuru	11·85	15	1·95	10·67
Collingwood	10·72	16	2·85	10·28
Nelson	2·93	14	1·22	3·54
Spring Creek	1·82	11	0·90	2·99
Hanmer Springs	1·48	11	0·50	3·56
Highfield, Waiau	1·07	6	0·36	2·50
Gore Bay	0·83	9	0·18	2·80
Christchurch	1·15	12	0·28	2·68
Timaru	0·56	4	0·43	1·75
Lambrook Station, Fairlie	0·39	3	0·31	1·90
Benmore Station, Clearburn	0·70	8	0·25	1·85
Oamaru	0·56	8	0·34	2·01
Queenstown	0·91	7	0·53	2·32
Clyde	0·39	5	0·19	0·93
Dunedin	2·85	22	0·43	3·16
Wendon	3·96	16	1·11	2·50
Gore	5·15	23	1·28	2·83
Invercargill	7·06	26	0·94	3·63
Puysegur Point	8·70	27	1·53	6·47
Half-moon Bay	6·92	23	1·35	4·79

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

LICK FOR DAIRY COWS.

"CATTLE LICK," Marton :—

Recently I made a lick for dairy cows of the following materials: 28 lb. coarse salt, 20 lb. air-slaked lime, 50 lb. bone-flour, 2 lb. sulphate iron, and 3 oz. potassium iodide. Could you suggest an improvement on this mixture, and also how to treat it to stop it from being blown away by the wind, for even if it is put in a covered container it will be affected by the wind? The air-slaked lime is very light, and it has occurred to me that perhaps it would be better to replace the 20 lb. of lime with a similar amount of salt and put lime in the drinking-water.

The Live-stock Division :—

The following lick is suggested as being suitable for your district. Containing more salt and omitting the air-slaked lime, this lick should be more suitable for use in covered containers. Add 50 lb. salt to 50 lb. bone-flour. These two are thoroughly mixed together and sprayed with a solution containing ¼ oz. potassium iodide dissolved in a small quantity of water. Iron is not necessary in the Marton district. If it is desired to supplement this lick by increasing the available phosphates, 1 lb. of superphosphate may be added to 100 gallons of the drinking-water.

GROWING TIMOTHY FOR SEED CROP.

"MATAURA," Waikoikoi :—

Kindly let me know how many pounds of timothy is required to sow down a paddock for harvesting for seed; and would it be ready to harvest the year after sowing, or would it take longer?

The Fields Division :—

It is customary to sow 15 lb. of timothy seed per acre when sowing alone. Ordinarily, timothy sown in the autumn would be ready to harvest the following January, but if spring-sown—for example in 1932—it would not be ready for harvesting until January, 1934, unless favoured by exceptional circumstances. A good average yield should be in the vicinity of 500 lb. per acre.

FOWLS WITH FOOT TROUBLE.

"AMATEUR," Athol, Southland :—

For some time past first one of my hens then another has become lame and gradually grown worse, until it either had to be killed or died. A lump seems to form under the foot, and causes the trouble so far as I can see. As all are young birds, I would be greatly obliged if you could advise what is wrong, and, if possible, suggest a remedy.

The Live-stock Division :—

Judging from your remarks it may be taken for granted that no form of disease is present, but that the birds referred to suffered from corns. The most common cause of corns is abnormal pressure on the feet such as is caused by the birds flying down from a high perch to a hard floor, or in being compelled to exercise on hard or stony runs. We have, however, seen many cases of the kind brought about by a prick from a thorn, &c., when the birds are on a free range, or when thistles or pieces of gorse have been among the litter used in the house. Your only safe course, therefore, is to endeavour to find the cause and remove it. The perches should not be higher than 18 in. from the floor of the house,

and the floor should be covered with straw or similar material to provide a soft place for the birds to land when leaving the perches. For treatment we would advise painting the affected feet with iodine, say, every other day. The feet may also be successfully treated with a bluestone solution. Dissolve a piece of bluestone about the size of a walnut in ½ pint of hot water, and when the solution is cool dip the affected foot into it. An affected bird should not be allowed to perch, care being taken that she is provided with soft bedding.

STRAWBERRY-PLANTS DESTROYED BY GRASS-GRUB.

M. M., Hastings :—

All my last year's strawberry-plants are practically destroyed by the grass-grub. Would carbon bisulphide be of use if applied, say, 8 in. deep, at intervals of 2 ft.? And what month would be best to apply it?

The Horticulture Division :—

If the soil is light this pest can do great damage to a plantation of strawberries, and in the drier districts it is often impossible to grow them in land of that kind. So far, fumigants have not been of great practical assistance under those conditions. The carbon bisulphide you suggest would certainly kill the larvæ, but would also most likely injure the plants if used to the extent necessary to kill the pest. Some very interesting experiments in this regard were carried out by the Orchard Instructor for the Hawke's Bay district last season, and you could not do better than discuss the problem with him, as all the circumstances could then be considered.

CREAM OF HONEY.

"APIARY," Rotorua :—

We recently purchased some honey from a local store, which has granulated, but is very soft and smooth, being almost semi-liquid. It is labelled "Creme Whipt Honey," and the label states that the contents are a specially prepared honey which will always keep soft and creamy. Can you tell me how to treat honey to make it like this?

The Horticulture Division :—

The article you refer to is produced by processing honey that has granulated solid. The processing breaks up the arrangement of the crystals, and the product is soft and creamy. A superior product can be made by grinding granulated honey in a meal or flour grinder, providing the adjustment and the speed of the machine are right. The cream of honey may be run direct into tins or glass containers. Ordinary room temperature will not affect it.

LAMPAS IN HORSES.

"LAMPAS," Eltham :—

Will you tell me the best treatment for a horse with lampas?

The Live-stock Division :—

Lampas in horses is a term applied to congestion and swelling of the mucous membrane of the hard palate of the mouth, especially behind the incisor teeth. It is a minor affection associated in the young horse with the process of dentition, and in aged animals with digestive disturbance. In the former instance, favourable results are obtained by giving a few bran mashes at intervals, to which has been added from 1 oz. to 2 oz. of Glauber salts. If there is any difficulty in mastication, oats may be crushed for a few weeks. Lancing of the gums is not recommended, as there is a danger of wounding the palative arteries. The use of the cautery or firing is positively barbarous, and should not be allowed. The condition is only a temporary one in young horses. When associated with digestive disturbance in aged horses, attention should be paid to the molar teeth. All irregularities should be removed to ensure thorough mastication of the food. Here, again, bran mashes should be given to which salts and baking-soda have been added in ½ oz. doses. Undue importance is often attached to the condition known as lampas, whereas in reality the trouble is invariably due to the teeth.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 19th May to 30th June, 1932, include the following of agricultural interest:—

No. 65952: Packhorse manure and seed distributor; R. B D. Walker. No. 68096: Tine harrow; J. E. Jeffs. No. 68207: Wire-strainer; R. H. Logan. No. 68385: Tractor, J Donaldson. No. 67053: Dressing-apparatus of clover-shellers, W. L Donald. No. 67137: Manure distributor; D. A. Dunn. No. 67141: Separating and collecting fruit juices and pulp; F R. Shirtclift No. 67176: Milking-machine; C. A. Martin No. 67283: Hay and ensilage knife; I. A. Smith. No. 67638: Extraction of vegetable fibre; E. V. Hayes-Gratze No. 68352: Machine for scouring wool; E. V. Hayes-Gratze. No. 68523 Tractor-wheel; A. Charter. No. 66693: Seed-blocks; International Skogplantingsmetode Aktieskelskap. No. 67365: Teat-cup; A. J. Lickfold. No. 67456: Milk-claw; G. R. Terry. No. 67524: Cheese; A T. Ross. No. 67548: Determining the fat-plus-casein content of milk; G. M. Moir. No. 67607: Wiring cheese-crates; D. A. Dunn. No 68769: Milking-machine claw; International Harvester Co. of N.Z., Ltd.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

BOOKS RECEIVED.

GROWTH AND THE DEVELOPMENT OF MUTTON QUALITIES IN THE SHEEP: A SURVEY OF THE PROBLEMS INVOLVED IN MUTTON PRODUCTION. By John Hammond, Institute of Animal Nutrition, School of Agriculture, University of Cambridge, 597 pages, with illustrations. Oliver and Boyd, Edinburgh and London. 42s. net.

AGRICULTURE: A TEXT BOOK FOR NEW ZEALAND SCHOOLS AND COLLEGES. By R. P. Connell, Fields Division, Department of Agriculture, and J. W. Hadfield, Agronomist, Plant Research Station, Palmerston North. Fourth edition, revised and enlarged. Whitcombe and Tombs, Ltd., Wellington, &c. 6s. 6d.

A MANUAL OF BEEKEEPING FOR ENGLISH-SPEAKING BEEKEEPERS. By E. B. Wedmore. Edwin Arnold and Co., London. 15s. net.

PASTURE PLANTS AND PASTURES OF NEW ZEALAND. By F. W. Hilgendorf, Canterbury Agricultural College, Lincoln. Third edition, revised. Whitcombe and Tombs, Ltd., Wellington, &c. 2s. 6d.

FRUIT TREE AND GRAPE VINE PRUNING. By George Quinn, Chief Horticultural Instructor, Department of Agriculture, South Australia. Robertson and Mullens, Ltd., Melbourne. 5s.

THE MARKETING OF RABBIT FLESH. By W. King Wilson, Rabbit Specialist, Harper Adams Agricultural College. Watmoughs Ltd., Bradford and London. 1s. 6d.

THE MAINTENANCE OF SOIL FERTILITY: FACTS AND FIGURES ON THE USE OF FERTILIZERS. Kempthorne, Prosser, and Co., Ltd., Dunedin, &c.

Corky Pit of Apples.—Referring to this trouble, Mr. M. Davey, Orchard Instructor, Mapua, remarks: "Corky pit has been of serious economic importance in the Nelson district during the past season, and in the absence of direct evidence I am inclined to consider that deep cultivation with heavy disks is aggravating if not creating a great deal of the trouble. It is reasonable to suppose that the cutting of large numbers of the surface roots must not only disturb the normal balance of the tree, but will also deprive the tree of nutriment at a period in which it is most essential. The fact that trees on the ridges, which in most instances are found to be largely surface-rooting, are the worst sufferers seems to strengthen this contention."

The New Zealand

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TYPES OF KALE GROWN IN NEW ZEALAND.

J. W. HADFIELD and R. A. CALDER, Plant Research Station, Palmerston North.

A CERTAIN amount of misunderstanding having existed in connection with the nomenclature of the several kales used in New Zealand, an investigation has been made recently by the Plant Research Station with the purpose of defining the various types. Samples were collected from all possible sources, seed sown in the nursery, and seedlings transplanted 2 ft. apart each way. This spacing enabled each plant to have reasonable scope for development and facilitated the detection of points of difference. Material collected comprised: (1) Rape-kale, (2) Buda kale, (3) thousand-headed kale, and (4) chou moellier, or marrow-stem kale.

RAPE-KALE.

Rape-kale is not used extensively in New Zealand, but there are certain districts in which it would be grown were it possible to place greater reliance on its type purity. There are two very distinct types. One, described as an early giant form, bears smooth leaves, the other, a late or long-standing form, has leaves which are very much curled. (Figs. 1 and 2.) In neither case is there any very definite stem development.

Field evidence, which is confirmed in our trials, indicates that the late or curly-leaved type is not very palatable to sheep. At this Station during the past two years it has not been as productive as the early type, and once cut back has given practically no second growth. The samples of the late type sent in for trial have proved, however, to be pure with little or no variation. On the other hand, the early type is generally mixed, and contains a proportion of late curly-leaved plants and a large number of intermediate forms. (Fig. 3.) The yield and recovery of the true smooth-leaved early type has been exceptionally good, but the intermediate and curly-leaved plants, present as impurities, detract from its value in that they are more or less similar in behaviour to the late type.

FIG. 1. EARLY GIANT RAPE-KALE.

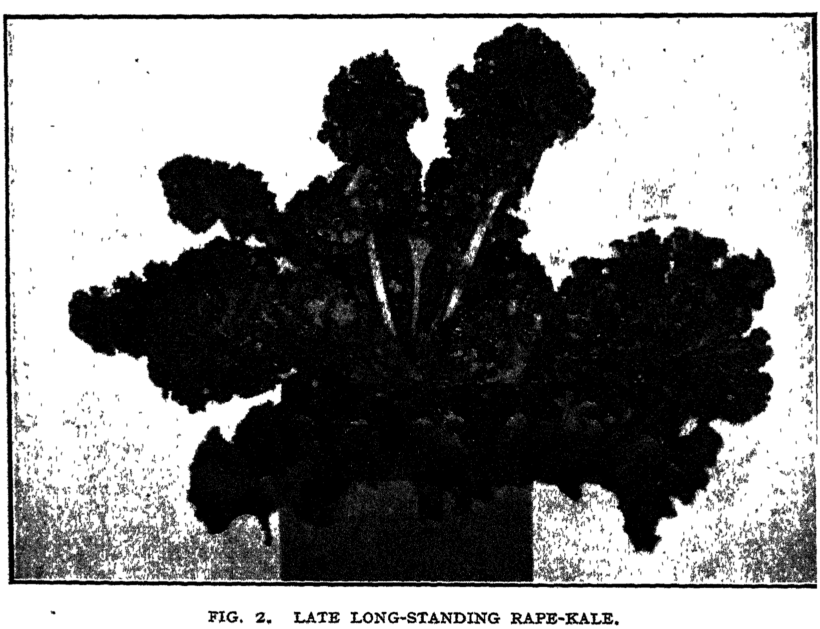

FIG. 2. LATE LONG-STANDING RAPE-KALE.

FIG. 3. INTERMEDIATE FORM OF RAPE-KALE.

Numerous intermediate forms appear in the early rape-kale, indicating that the type is not fixed.

BUDA KALE.

There is reason to doubt whether the Buda kale of to-day is the same as the fodder crop which years ago gained such popularity in certain parts of the North Island under this name. Considerable difference of opinion exists as to the type of plant that should be regarded as the true Buda kale. Two very distinct types have been sent in by merchants for trial. So far as we can judge from appearance, behaviour, and chemical analysis, one type is identical with rape, and would be included without any hesitation as Type 2 rape in our classification. (See "Types of Rape used in New Zealand," this *Journal*, October, 1931, page 255.) This Buda kale is illustrated in Fig. 4. The seed is identical with that of rape, and the following direct comparisons have been made which show a striking degree of similarity in other respects.

Table 1.—Comparisons between the Rape-like Buda Kale and Rape.

Points of Comparison.		Rape-like Buda Kale.	Type 2 Rape.
Dry matter percentage		9·73	11·29
Ether extract	Expressed as a percentage of dry matter	5·16	5·09
Fibre		10·74	10·73
Protein		29·90	29·20
Nitrogen-free extract		40·88	42·48
Ash		13·32	12·50
Leaf blade percentage		35	37
Leaf stalk and mid-rib percentage ..		65	63

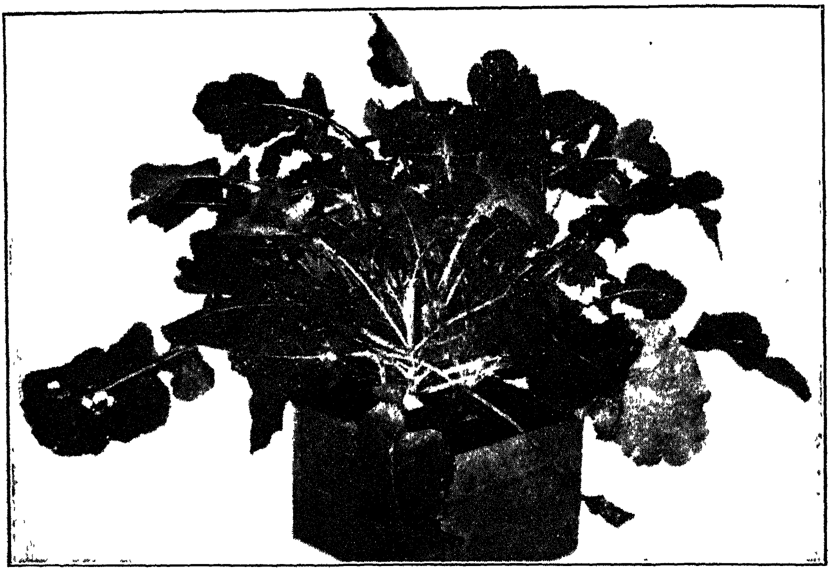

FIG. 4. A FORM OF BUDA KALE WHICH IS IDENTICAL WITH RAPE.

FIG. 5. BUDA KALE.
The leaves are thick and fleshy, and resemble those of a cabbage.

The second type of Buda kale is distinct in every respect, even the seed appearing quite dissimilar. This type is illustrated in Fig. 5. The leaves are thick and fleshy—more in the nature of cabbage-leaves.

While we cannot detect any difference between rape and the rape-like Buda kale, yet the fleshy-leaved type is distinct from any material we have had under trial, and we think this may be regarded with justification as the true Buda kale.

Thousand-headed Kale.

No marked variations could be noted in the samples under trial, and all were characteristically branched. The illustration (Fig. 6) is of a young plant in which no very definite stem formation has yet

FIG. 6. THOUSAND-HEADED KALE.

developed. At a later stage a hard, woody, and unpalatable stem is produced from which arise numerous lateral shoots. It is from this feature that its name arises.

Chou Moellier, or Marrow-stem Kale.

All lines of this variety sent in proved to be pure and true to type. A central stem is developed very early and bears large fleshy leaves. There is little or no lateral branching. The stem is enlarged and consists of a hard outer layer of woody tissue surrounding a soft and palatable core; hence the name marrow-stem kale. (Fig. 7.)

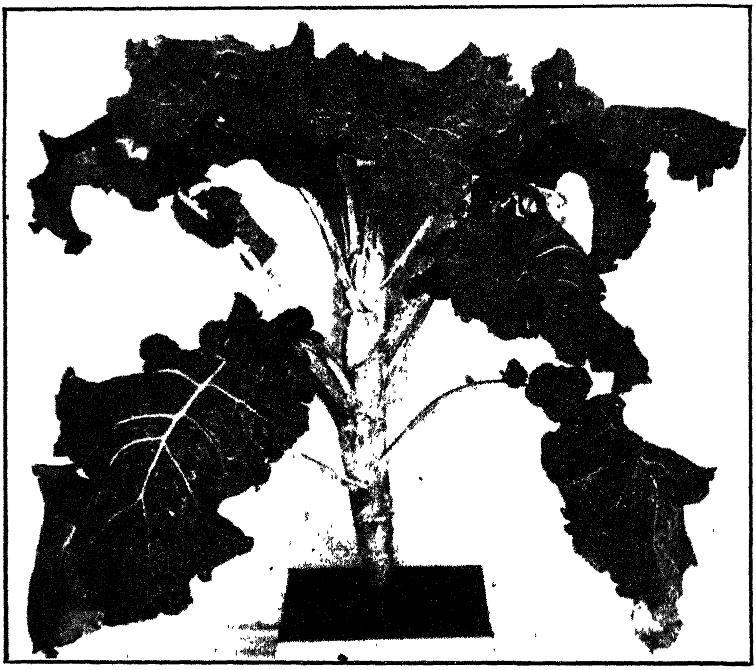

FIG. 7. CHOU MOELLIER, OR MARROW-STEM KALE.

In this, as in thousand-headed kale, there appears to be no misunderstanding as regards nomenclature.

ANALYSES OF KALES.

Seed was sown in the nursery at the end of October last, and a month later the seedlings were transplanted 2 ft. apart each way. Samples for analysis, representing four months' growth, were taken on 26th February.

At this stage the rape-kale and Buda kale were probably at their best, but under normal conditions the chou moellier and thousand-headed kale would have stood for a longer period before being utilized. On the other hand, the rape which has been included for purposes of comparison was perhaps slightly overmature. This point is emphasized because the stage of maturity has probably a direct bearing on chemical analysis and palatability, although it is a matter for conjecture as to just how far or in what direction this factor influences the results obtained.

The analyses of rape given in Table 2 are an average of the three types described in the *Journal* for October, 1931. All samples were collected from the one area and from plants receiving similar treatment. The only factor in doubt and which might upset comparisons has been that of maturity.

Table 2.—Chemical Analyses of Rape and Kales.

Variety.	Sample.	Dry Matter Percentage.	Percentages of Dry Matter.				
			Ether Extract (Crude Fat).	Fibre.	Protein.	Nitrogen-free Extractives.	Ash
Rape ..	Whole plant..	11·36	4·80	10·52	29·29	43·70	11·69
	Leaf-blade ..	15·35	4·89	11·58	42·90	31·95	8·68
	Mid-rib and stalk of leaf	7·84	2·87	13·08	25·72	44·97	13·36
Rape-kale	Late type ..	10·51	4·70	11·28	32·58	39·94	11·50
	Early (smooth)	10·57	4·97	11·48	25·78	45·01	12·76
	Early (medium wrinkled). (Fig. 3)	9·66	7·0	7·1	32·64	41·84	11·42
Buda kale	Fleshy - leaved type	9·95	5·50	11·74	32·03	37·59	13·14
	Rape type ..	9·73	5·16	10·74	29·90	40·88	13·32
Thousand-headed kale	Leaf, including mid-rib and stalk	10·90	4·51	10·54	23·28	48·12	13·55
	Stem ..	17·39	2·05	28·05	15·24	41·28	13·38
Chou moellier	Leaf, including mid-rib and stalk	9·88	4·05	11·64	20·50	50·03	13·78
	Stem ..	15·98	2·27	20·78	20·40	37·25	19·30

—*Analyses by B. W. Doak, Plant Research Station.*

PALATABILITY TRIALS.

Small plots of all the kales sent in for trial were grown at the Marton Experimental Area under the direction of the Fields Superintendent, Palmerston North. They were sown on land adjoining a grass paddock, and by removing the dividing netting sheep were admitted. Records were taken periodically by the overseer of the proportion of each line consumed. The area was dressed with 3 cwt. of superphosphate, and sowing took place on 19th November, 1931.

Table 3.—Palatability Trials with Kales, Season 1931–32.

Variety.	Yield, 12/2/32 (Maximum 10)	Percentage grazed on Dates indicated.						Recovery, 9/5/32. Max. 10.
		15/2/32.	16/2/32.	18/2/32.	19/2/32.	22/2/32.	23/2/32.	
Thousand-headed kale	7·9	Nil	Nil	10	24	71	100	5·5
Rape-kale, late	3·0	Nil	5	70	82	92	100	2·0
Rape-kale, early	8·5	3·2	60	100	..	..	..	3·5
Fleshy-leaved Buda kale	6·7	65	95	100	..	..	..	2·5
Rape-like Buda kale	7·5	50	82	100	..	..	..	2·0

On 12th February, 1932, an estimate of yield was taken, and on the 13th ten sheep of mixed ages and sexes were put on the plots. On the 15th for the first time, and thereafter periodically, an estimate was made of the proportion grazed on each plot. Results are shown in Table 3; the figures are averages for each variety under trial.

The outstanding feature in this table is the low palatability at this stage of thousand-headed kale and late rape-kale. These were not grazed to any extent until the others were practically eaten out. The low initial yield of the late rape-kale, and its small recovery, together with its unpalatable nature, render it of doubtful value.

It will be appreciated that the recoveries taken on 9th May are not altogether a fair estimate, since the more palatable varieties were grazed much more severely and over a longer period.

ORCHARD SPRAYS IN NEW ZEALAND.

III. THE COPPER SERIES—*continued.*

G. H CUNNINGHAM, Mycologist, Plant Research Station, Palmerston North.

2. Burgundy Mixture.

This spray was first used by Masson (1887) in France for the control of downy mildew (*Plasmopara viticola*) of the grape. Masson's experiments were conducted in the province of Burgundy, hence the popular name. The spray is prepared in a similar manner to bordeaux mixture, save that washing-soda (sodium carbonate, Na_2CO_3) is used in place of lime.

The chemistry of burgundy mixture was partially studied by Pickering (1910), who stated that the reactions between copper sulphate and washing-soda led to the production of a basic copper carbonate, and in addition to sodium sulphate and sodium bicarbonate. Pickering found that when the mixture was prepared in the proportions (by weight) of 1 : 1·84 practically all the copper was precipitated. As a result of this investigation he recommended the formula 5–9–50 for the preparation of burgundy mixture.

This spray (in the formula of 4–5–40) has been popular in New Zealand, specially among nurserymen, florists, and small-fruit growers, owing to the ease with which small quantities can be prepared, and to the relative purity, availability, and ease of storage of the washing-soda. The introduction of hydrated lime has made the preparation of bordeaux mixture as simple as that of burgundy; consequently, as the latter is inferior to bordeaux in several respects (being more liable to cause injury when used as a summer spray, especially if mixed with lead arsenate), there is no valid reason why it should any longer occupy a place in the spray programme when hydrated lime is available.

3. Other Copper Sprays.

(a) The Cuprammonium Sprays.—By adding ammonia to copper sulphate solution it is possible to prepare a spray which differs from bordeaux and burgundy in that, instead of a precipitate, a deep blue

solution is formed. Similar sprays may be prepared by using ammonium carbonate in place of ammonia, or by replacing copper sulphate with metallic copper or the so-called copper carbonate of commerce. The advantage claimed for the ammonia spray is that, being in the form of a solution, it does not disfigure fruit or foliage to which it is applied. In practice, however, it has been found that a certain amount of deposit is present on sprayed plants.

(b) Cheshunt Compound.—A soil fungicide which may be used with safety in the vicinity of growing plants has been recommended by Bewley (1922). This preparation (termed "Cheshunt Compound," after its place of origin, the Cheshunt Experimental Station, England) is prepared by mixing 2 parts (by weight) of powdered copper sulphate with 11 parts of freshly powdered ammonium carbonate. Following mixing the preparation is stored for twenty-four hours before using in an airtight glass or stone jar, and in this form may be kept indefinitely. One ounce of this dry mixture is dissolved in ½ pint of hot water, and added to 2 gallons of cold water. The solution should be used as rapidly as possible after preparation. This solution may be applied to the soil in which plants are growing without causing injury, and is thus of value in combating damping-off, fusarium-wilt of tomato, and other related diseases of seed-boxes and the glasshouse.

(c) Copper Acetate. — Copper acetate sprays have been used in France for many years. Butler and Smith (1922) have recently studied their behaviour and preparation, and claim that they are non-toxic to the plant, form less conspicuous spray deposits than the cuprammonium sprays, and compare favourably with bordeaux mixture as fungicides. There are two types of these recommended, the neutral and the basic, depending on whether the neutral or basic acetate of copper is used in its preparation. Their relatively high cost when compared with bordeaux mixture have limited the use of these sprays.

(d) Colloidal Copper Hydroxide.—This preparation, made by precipitating copper hydroxide from a solution of copper sulphate, by treatment with a 10-per-cent. solution of sodium hydroxide, has been stated by Hooker (1923, 1925) to give control equal to bordeaux mixture 3–4–50, when used at a dilution containing one-fifteenth the copper present in the bordeaux. Its application does not appear to have been carried beyond the experimental stage, possibly because of the difficulty of preparing a homogeneous mixture, and the relatively high cost of the final product.

(e) Copper Sulphate Solution.—This has been recommended at different times as a spray for dormant trees. In New Zealand it has been used for this purpose at the rate of from 5 lb. to 10 lb. to 50 gallons of water, and has been applied at the same strengths to potatoes as a controllant of late-blight. The solution has been found to cause severe injury both on dormant trees (especially peaches and nectarines) and on potatoes, even at dilutions in excess of those recommended, and for this reason it is not to be recommended as a spray.

(f) Copper-lime Dusts.—Although these have been used to a certain extent in North America, those tried out in New Zealand have proved worthless as controllants of orchard diseases, and in addition have frequently caused severe injury. The cost of these dusts in the

Dominion is from three to five times as great as that of comparable bordeaux sprays, and as they have proved of little value as fungicides it is obvious that they have no place in the spray programme.

EFFECTS OF COPPER SPRAYS UPON FUNGI AND PLANTS.

(a) Factors affecting Fungicidal Efficiency.—Copper sprays have proved to be the most effective fungicides known, save against the rust fungi and true mildews, and in consequence have had a wide application.

The fungicidal action of bordeaux mixture (and also of most of the other copper fungicides discussed) is dependent upon certain factors, as (1) the proportions of copper sulphate to lime used in preparing the spray; (2) the time of application; (3) the type of organism against which it is being used; (4) the type of plant to which it is being applied; and (5) meteorological conditions during and following application.

The proportions of copper sulphate to lime directly affect the solubility of the spray, and this in turn affects its lasting properties upon the plant. Thus Pickering (1907), and Bedford and Pickering (1910, and 1919, p. 182) have shown that if the proportions are in the region of 6 parts of copper sulphate to 1 part of lime (by weight), 25 per cent. of the total copper is liberated; if the proportions are approximately 4 : 1, then 10 per cent. is liberated; whereas if the proportions are 1 : 1 (as in the "equal" bordeaux chiefly in use to-day) no copper is liberated until several hours after mixing, the amount gradually passing into solution being between 1 and 3 per cent., according to the quantity of excess lime used, and to certain other factors which need not be discussed. These workers concluded that, if judged by the fungicidal efficiency alone, a bordeaux prepared in the 6 : 1 proportions would be about twelve (or possibly eighteen) times as effective as an "equal" bordeaux in which the same amount of copper sulphate was used. But in practice they found that the effectiveness was actually only five times as great.

Experience has shown that a bordeaux with a high soluble copper content is unsafe to use, even on dormant trees, causing injury of a type similar to that produced by copper sulphate alone. It has been found that bordeaux sprays with a high soluble* copper content are relatively inefficient when compared with the "equal" type (that is, sprays in which copper sulphate and lime are used in equal proportions), largely owing to their solubility being such that they remain on the plant for a relatively short time only. As the principal object in applying a bordeaux spray (especially in the earlier parts of the season) is to cover the foliage and fruits with a protective cover, it is evident that the more insoluble the spray the longer it will persist, and therefore the more effective it will prove, within limits. The necessary decrease in available copper and persistence upon the plant are secured by increasing the quantities of lime in relation to the amount of copper sulphate used, for it has been shown that an increase in the proportion of lime in the mixture decreases the solubility of

* "Soluble copper" does not mean that free metallic copper is present in the solution, but that the copper is present in the form of soluble organic or inorganic salts.

the copper up to the point where the proportions of copper sulphate and lime are about the same, as in the "equal" types of bordeaux.

The time of application is significant in that it affects the amount of spray injury which may follow. Consequently different dilutions of spray are used during different periods of the year, for a spray with a relatively high soluble copper content may be applied with a reasonable degree of safety during the dormant or semi-dormant period, yet be quite unsafe to apply during the actively growing period. For this reason it is customary to recommend two formulæ, one for winter the other for summer application. There is a growing tendency, however, to recommend for use at all seasons the formula which may be used with safety during the growing period, for it is becoming recognized that many of the "winter" formulæ contain excessive amounts of copper sulphate, and are not only likely to cause injury but are unnecessarily expensive.

The concentration of the spray, and incidentally its time of application, are determined to a certain extent by the type of disease-producing organism against which a spray is applied. Thus in combating leaf-curl of peaches it is well known that control depends not so much upon the formula used in the preparation of the spray as upon the time of application, which is judged by the period of development of the tree. Summer applications, however numerous, are of little worth in combating this disease. Again, with many diseases which appear only during the growing season, dormant applications are useless. Furthermore, the rust fungi and true mildews cannot be combated by applications of bordeaux mixture or other copper compounds here discussed.

The type of plant limits the application of bordeaux mixture, for some will tolerate this spray throughout the growing period, whereas others suffer severe injury following even dilute applications. Thus, under New Zealand conditions, it is unsafe to apply bordeaux mixture to peaches or apples during the summer months, yet quite safe to use this spray on most varieties of pears, small-fruits, and potatoes. Dilution makes it possible to spray certain of these intolerant plants (as most varieties of apples) provided it is carried to a sufficiently low point; but this introduces the possibility of inefficient control of disease, and should not on this account be attempted unless supported by experiments conducted over several seasons.

Certain meteorological conditions, such as rainfall and atmospheric humidity, may affect both the persistence of the spray and its effects upon the tree. Orchardists are familiar with the fact that bordeaux remains but a brief time on the plant if application is followed by rain, and it appears that plants in localities of high humidity are more intolerant of this spray than those grown in areas with a low humidity.

(b) Effects upon Fungi.—The actual manner in which bordeaux mixture or other copper sprays act as a fungicide is still in dispute. A review of the literature shows that the copper is apparently the active agent, and this may act either in the form of soluble copper salts or as solid particles.

Where soluble copper is considered to be the active agent it is believed that it is liberated from the insoluble copper hydroxide (or basic carbonates of many workers) by (1) solvent action of the fungus, (2) secretions produced by the host plant, (3) by the carbon dioxide of

the atmosphere dissolved in the precipitation moisture covering surfaces of leaves and fruits, or (4) other chemical substances present in minute quantities in the atmosphere.

It has been demonstrated experimentally that soluble copper salts are toxic to spores and hyphæ of many species of fungi, and it is this knowledge which has led to the general belief that soluble copper is the active agent. Cerasoli (1921) demonstrated that grape leaves infected with downy-mildew possessed an acid reaction, and considered that the action of weak acids or acid salts excreted by this fungus during its entry into the tissues brought about solution of copper salts. Bedford and Pickering (1910) found that apple laterals infected with powdery-mildew also possessed the ability to liberate soluble copper, but found that the spores alone were unable to act similarly. They (1919, p. 188) demonstrated that certain plant decoctions, secretions from injured leaves and from apparently uninjured leaves of certain plants, were able to liberate copper salts from bordeaux mixture. Millardet and Gayon (1887) showed that soluble copper was present in rain water dripping from sprayed plants, and concluded that this was liberated by the action of carbon dioxide and traces of ammonium compounds present in rain water.

From these particulars it is evident that copper salts may be liberated when in contact with plants which are infected with certain fungi; but whether this action is due to the fungus or to secretions from injured plant tissues (injuries induced by fungi, insects, or mechanical means) is not clear, owing to the experimental difficulties which must be overcome before definite proof is forthcoming. That atmospheric moisture is in some manner connected with solubility of bordeaux or burgundy mixtures is evidenced by the fact that spray injury is present to a greater extent in regions of high than of low humidity.

A belief that copper sprays act as fungicides because the copper is in the form of solid particles (of copper oxide) has been supported by the Villedieux (1924) and Chaine (1929). But this belief is scarcely justified by the experimental evidence submitted by these workers.

(c) Effects upon the Plant.—(1) Spray injury: This would appear to be governed by the degree of spray tolerance of the plant and the percentage of soluble copper liberated by the particular spray used.

On leaves injury is usually indicated by the appearance of discoloured spots or blotches, the affected portions usually becoming brown and ultimately dying. Injury of this type is rare on pome fruits, potatoes, tomatoes, and small-fruits (unless the quantities of spray used are excessive) but is often severe on peaches, nectarines, apricots, and certain varieties of plums. It is a feature of injury of this type that it is more noticeable towards the latter part of the growing season, and is especially troublesome on leaves which have been injured by insect attack, probably because of the greater liberation of soluble copper. On stone fruits severe cases of summer spray injury are often followed by partial defoliation.

On fruits injury assumes the appearance of russet, and is usually severe only during the earlier stages of development. In the Dominion apples suffer severely in this respect, irrespective of the dilution of

bordeaux used, and in consequence this spray has been replaced by lime-sulphur as a summer fungicide. On peaches and apricots spray injury is usually indicated by fruit drop, but where the fruits persist they often show disfigurement and in extreme cases distortion. Cherries especially are liable to this type of injury. Plums of certain varieties will tolerate summer dilutions of bordeaux mixture without injury.

Naturally, injury depends on the dilutions and proportions of the spray, and to a lesser extent on meteorological conditions. Unfortunately, even at dilutions considerably in excess of those recommended, russet of certain varieties of apples and leaf injury of stone fruits is liable to occur, and for this reason summer applications of bordeaux are confined to most varieties of pears, to potatoes, tomatoes, and small-fruits.

(2) Spray stimulus: It has long been known that copper sprays often appear to induce a healthier foliage, which tends to persist for a longer time than that of unsprayed plants or those sprayed with lime-sulphur. This has been attributed to several factors. Thus by several workers the stimulatory effect has been considered as being due to an increase of chlorophyll content of the leaf, and consequently to an increase of carbon assimilation, either by the effect of minute quantities of copper or of iron present in the copper sulphate as an impurity. But as this healthy foliage is also apparent in plants sprayed with colloidal sulphur, it is evident that this explanation does not account satisfactorily for the apparent benefit.

A second hypothesis is to the effect that the dense coating applied tends to slow down the metabolic processes of the leaf—and, by partial blockage of the stomata, that of transpiration—to such an extent that the life of the leaf is prolonged. This also, is open to criticism, since the stimulatory effect is apparent when leaves are sprayed with copper-ammonium sprays, which, being solutions, do not leave a solid residue.

It is probable that the explanation is much simpler, and that the benefit of spraying is attibutable to protection from the attacks of leaf parasites.

Recommendations for the Use of Copper Sprays.

From the foregoing matter it is evident that finality has not been reached in improving copper sprays, but, pending further experiments, it is inadvisable to make recommendations other than those based on results secured in the past. These results show that, of the copper series, bordeaux mixture is the most efficient spray; consequently recommendations will be confined to the application of this spray under New Zealand conditions.

Growers may use hydrated lime bordeaux in preference to quicklime bordeaux with every confidence, since in our experiments of the past three seasons it has given equally efficient results, and has the added merit of being much easier to prepare. Since 1 lb. of quicklime is equivalent to 1·32 lb. of hydrated lime, some variation in the recommended formulæ might be expected with the replacement of quicklime by hydrated lime. Experience has shown, however, that owing to the finer state of division and greater purity of the hydrated lime the same formula may be used for either hydrated lime or quicklime bordeaux mixture.

The following formulæ are recommended until such time as they may be improved by further experiments: 5-4-50 for dormant or semi-dormant applications, and 3-4-50 for summer use.

To prepare bordeaux mixture, fill the spray tank about three parts full with water; dissolve the required quantity of copper sulphate in water (5 lb. for each 50 gallons of water), add to the tank, and start the agitator running. The copper sulphate may be dissolved with rapidity if hot water is used (5 lb. will go into solution in a minute or so in 1 gallon of boiling water), or, if first powdered, may be added directly to the spray tank according to the method described under instant bordeaux, in which case it will go into solution within two minutes. When the dissolved copper sulphate has been added to the tank, weigh out the required quantity of hydrated lime (4 lb. for each 50 gallons of water), mix to a thin paste with cold water, and with the agitator still running pour slowly into the tank, at the same time filling the tank to its capacity. Keep the agitator running for a further few minutes, and the spray is then ready for application.

As a foundation spray in the control of black-spot of apples, one application only of 5-4-50 bordeaux is recommended to be applied at green-tip, this being preferable to lime-sulphur. For black-spot of pears, two applications of this strength may be used, one at green-tip, a second at pre-pink; and further applications of bordeaux 3-4-50 may be made at intervals through the growing season. Where black-spot is absent but powdery-mildew prevalent, the use of lime-sulphur is advised, since bordeaux mixture will not combat the latter disease.

For control of brown-rot, leaf-curl, and other fungous diseases of stone fruits, one application (or preferably two) of 5-4-50 bordeaux at bud-movement is recommended. As bud-movement is often difficult to define, and varies somewhat with different varieties and in different localities, even in the same orchard, it is preferable to use two close ratio applications at this strength, the first at pre-bud movement, the second at post-bud movement. If varieties are highly susceptible to brown-rot or leaf-rust, and moderately resistant to leaf-curl, it is advisable to use a lime-sulphur spray in addition to bordeaux. For although bordeaux is the most effective controllant of leaf-curl, shot-hole, bladder-plum, die-back, and certain other diseases, it is not as effective as lime-sulphur (or colloidal sulphur) against brown-rot, and is practically worthless against leaf-rust.

For diseases of potatoes and tomatoes bordeaux 5-4-50 should be used if the season is a wet one or where late-blight is prevalent; otherwise use 3-4-50.

For control of citrus-verrucosis of citrus fruits it has been found in the United States that a bordeaux and oil combination gave more satisfactory results than bordeaux alone, the combination being apparently first used by O'Byrne (1922). The procedure recommended (Winston, Bowman, and Yothers, 1923) is to add a 1-per-cent. solution of emulsified oil to the bordeaux. In New Zealand successful results have been secured with a 1-per-cent. solution of a white or summer oil added to a 3-4-50 bordeaux mixture. The combination is prepared by pouring the oil emulsion slowly into a full tank of bordeaux while the agitator is running The agitator must be kept running until the tank has been emptied, as the oil separates from the bordeaux if the mixture is allowed to stand. This combination will also combat insect pests, such as scale insects, of lemons and oranges.

Cheshunt compound may be used with safety in the form recommended as a controllant of damping-off in seed-boxes, or as a preventive of fusarium-wilt if this appears in tomatoes grown under glass.

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PASTURE ESTABLISHMENT ON RECLAIMED TIDAL FLATS.

SOME EXPERIMENTAL WORK AT WHANGAREI.

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THE harbours of North Auckland contain large areas of tidal flats bordering the main waterways and tidal rivers. The total area of such land in Whangarei Harbour which could be reclaimed by stop-banks is estimated at upwards of 6,000 acres, and in several of the other harbours still larger areas could be reclaimed.

These tidal lands vary in character. Three main types are represented: (1) Soils of a silty nature, which crack readily on draining and take grass well; (2) typical mangrove mud soils, stiff and impervious, and showing little tendency to crack; and (3) sandy soils, generally overlying beds of pipi-shells which are often quite close to the surface, showing no cracking even when thoroughly drained. The question of cracking is important in connection with the rapidity with which the salt is washed out of the soil. Of the three types the sand and shell soils occur in large areas in the east coast harbours, while the predominating type on the west coast is mangrove mud.

About seven years ago the Whangarei Harbour Board reclaimed, by constructing stop-banks and a flood-gate, about 100 acres adjacent to the town, mainly comprising sandy shell areas with mangrove mud bordering the water channels. When the water had been shut off for three years arrangements were made for the Department of Agriculture to carry out experimental work in the grassing of this land, an area of 16 acres being made available for the purpose. Open drains connected with the outlet drain were constructed round three sides of the area, which was about 13 chains square. Up to the present experimental work has been confined to an area of 9 acres, consisting practically all of the sand and shell type, covered originally with saliconia, which was still growing, though fleabane was commencing to appear, when the work commenced.

The experimental work was designed to test under-drainage compared with open drains, ploughing compared with surface cultivation, and autumn sowing of grass-seed compared with spring sowing. At the same time six grass-seed mixtures were made up by the Agrostologist, Plant Research Station, for trial purposes. These consisted of (1) a basal mixture of perennial rye 15 lb., Italian rye 5 lb., paspalum 4 lb., white clover (N.Z.) 1 lb., strawberry clover 1 lb., alsike 1 lb., and Lotus major 1 lb. per acre, to which the following were added for separate additional plots: (2) Cocksfoot 10 lb., crested dogstail 3 lb.; (3) browntop 2 lb.; (4) timothy 2 lb., meadow foxtail 4 lb., meadow fescue 6 lb.; (5) subterranean clover 1 lb., suckling clover 2 lb., Lotus hispidus 2 lb.; (6) red clover 3 lb., English trefoil 2 lb.

In December, 1928, 4½ acres were under-drained with manuka fascine drains placed 2 chains apart. Half this area and half the undrained section was ploughed and left fallow until March, and the remainder of the area surface cultivated with disk harrows. Early in April, 1929, the grass-seed was sown with 3 cwt. per acre of basic

superphosphate in plots 13 chains long across the different drainage and cultivation treatments. Half the area was left for spring sowing, but as it was not possible to work horses on the undrained area until late in November this section was left to be sown in the autumn of 1930.

The initial strike was quite satisfactory on the fascine-drained section, but the only species to establish on the undrained portion were perennial rye-grass and a little strawberry clover. Growth on the under-drained area was slow during the winter and early spring, but by the first summer the clovers commenced to come away, particularly the strawberry clover, and at the end of the first year quite a good sward of clovers had been established and the perennial rye began to strengthen up. During the second spring the rye-grass improved rapidly and white clover was more prominent, though still dominated by the strong growth of strawberry. Cocksfoot also showed up in the autumn, and paspalum plants were noticeable.

A still further improvement in the proportion of perennial rye and white clover to strawberry clover occurred in the third year, and at the time of writing an excellent sward of perennial rye, white clover, and strawberry clover is established in the under-drained area, with paspalum, cocksfoot, red clover, and alsike most prominent of the other species sown, several of which, however, have not shown up at all.

On the undrained portion a striking contrast was noticeable all through. With the exception of a strip alongside the last fascine drain, which has gradually extended from ½ chain at the end of the first year to about 1 chain or a little more at the present time, on which quite a good sward has established, the rest of the area lies wet and cold in the winter. It is devoid of grass except for patches of strawberry clover, which are gradually extending and being invaded by perennial rye and white clover.

Whereas the effect of the underground drains was noticeable for a distance of ½ chain in the first year, and rapidly extended to 1 chain or more at the end of the second year, the open drain alongside the plots has not affected the grass for more than ¾ chain out. This illustrates one advantage of closed drains. The initial strike and early growth was slightly better on the ploughed areas than on the surface cultivated ones, the difference being mainly in the better establishment and growth of perennial rye. The outstanding feature of the trial is the very striking effect of under-drainage on this type of land, which shows no tendency at all to crack or open up when dewatered and drained.

The plots included a small area of the mangrove mud type overlying a bed of shells at a greater depth than those on the sandy area. Here the only species to establish were brown-top, paspalum, and lotus species, none of which have grown well. After ploughing, most of the surface soil was carried away by a flood. This type tends to bake hard in the summer-time and is comparatively impervious to water in the winter, and is coming in much more slowly than the more typical sandy shell area adjoining. Rushes are also bad on the former area.

There is no doubt that here also under-drainage is an important factor in the more rapid establishment of grasses and clovers, among which paspalum and Lotus major may be expected to play a prominent part in establishing a sward, particularly if allowed to seed.

WHEAT-MANURING EXPERIMENTS IN THE SOUTH ISLAND, SEASON 1931–32.

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IN the 1931–32 season twenty-seven experiments on the manuring of wheat were laid down in Canterbury and North Otago, and one experiment was conducted in Southland at the Gore Experimental Area. In Canterbury and North Otago the season was abnormally dry through the spring and summer, and in certain localities crops were very poor and difficult to harvest. On this account four of the experiments had to be abandoned. The general method of conducting this class of experiments was described in the *Journal* for July, 1926.

Types of Experiment, 1931–32.—Three main types of experiment were carried out. Type A and, with certain modifications, Types B and C were a continuation of the previous season's programme. The treatments per acre for each type of experiment are shown below. Super and super plus lime were drilled in with the seed in all cases.

Type A—

(1) No manure.	
(2) Superphosphate (44/46)	1 cwt.
(3) Super	2 cwt.
(4) Super 1 cwt., plus nitrate of soda 1 cwt.	2 cwt.
(5) Super 2 cwt., plus nitrate of soda 1 cwt.	3 cwt.
(6) Super 1 cwt., plus carbonate of lime 2 cwt. ..	3 cwt.

Ten experiments of this type were carried out, two of which were abandoned. The nitrate of soda was top-dressed in the spring, during the latter part of September in most cases.

Type B—

(1) No manure.	
(2) Super	1 cwt.
(3) Super 1 cwt., plus nitrate of soda 1 cwt.	2 cwt.
(4) Super 1 cwt., plus nitrate of soda 1½ cwt.	2½ cwt.
(5) Super 1 cwt., plus sulphate of ammonia 1 cwt. ..	2 cwt.
(6) Super 1 cwt., plus sulphate of ammonia 1½ cwt. ..	2½ cwt.

Ten experiments of this type were carried out. The nitrate of soda was top-dressed during the latter part of September and the sulphate of ammonia about a month earlier. Nitrate of soda and sulphate of ammonia are compared on an equal weight of manure per-acre basis.

Type C—

	Time of Application of Nitrogen.
(1) Super.	
(2) Super 1 cwt., plus sulphate of ammonia 1 cwt.	With seed.*
(3) Super 1 cwt., plus nitrate of soda 149 lb. ..	Late August.
(4) Super 1 cwt., plus sulphate of ammonia 1 cwt.	Late August.
(5) Super 1 cwt., plus nitrate of soda 149 lb. ..	Late September.
(6) Super 1 cwt., plus sulphate of ammonia 1 cwt.	Late September.
(7) Super 1 cwt., plus nitrate of soda 149 lb. ..	Late October.

* Following on good results from applying sulphate of ammonia at time of seeding at the Waite Institute, South Australia, this treatment was included at the suggestion of Mr. W. V. Blewett, of Imperial Chemical Industries (Australia-New Zealand), Ltd.

Each nitrogen-treated plot received the same amount of *nitrogen* per acre (sulphate of ammonia = 20·6 per cent. N, nitrate of soda = 15·5 per cent. N). Four of this type of experiment were sown, but two had to be abandoned.

In addition to the above, an experiment conducted on the farm of F. W. Carpenter, Prebbleton, was on the same lines as the Type C experiments, except that calcium cyanamide was included. Certain plots having a basal dressing of super 1 cwt. received calcium cyanamide 1 cwt. per acre in late August; others received this amount of calcium cyanamide in September. Similar trials conducted on the same farm in previous years have been the subject of articles in the *Journal* (March, 1931, and July, 1931). Other trials of similar type were also discussed in the latter publication.

Miscellaneous Types.—One experiment using spring-sown wheat was laid down on the lines of Type A experiments referred to above, except that sulphate of ammonia was used instead of nitrate of soda and was applied with the seed. Sulphate of ammonia 1 cwt. per acre was also included with Treatment 6 (super 1 cwt., plus carbonate of lime 2 cwt.).

An experiment was carried out at the Gore Experimental Area (Southland) using the following treatments per acre: (1) No manure; (2) super 2 cwt.; (3) super 2 cwt., plus sulphate of potash 1 cwt.; (4) super 2 cwt., plus nitrate of soda 1 cwt.; (5) super 2 cwt., plus sulphate of potash 1 cwt., plus nitrate of soda 1 cwt. The nitrate of soda in Treatments 4 and 5 was top-dressed on 22nd October.

Size of Plot and Number of Replications.—As in the previous year each plot was 2 chains in length and 7 coulter rows wide. Twelve replications of each treatment were sown in each experiment, except Carpenter's, in which twenty-four replications were sown. In order to reduce the liability of "fertility slope" influencing yields, the treatments were arranged in opposite order on each side of a middle plot.

Interpretation of Results.—Results were examined statistically, although modern statistical thought demands randomization of treatments within each series, and this was not provided for reasons which need not be discussed here. Differences between treatments may be accepted with confidence when stated to be "significant." Where differences are "not significant" they may be real, but they cannot be accepted with any degree of confidence.

Estimation of Profits or Losses from Manures applied.—General averages are used for estimation of monetary returns in tables. The following prices are used for computing these returns, and in the case of manures are the approximate ex-store prices: Wheat 3s. 6d. per bushel (per bushel cost such as threshing, bags, hauling, railage, &c., are taken as about 1s., and this amount is deducted from the average price for Tuscan wheat delivered in store); superphosphate 4s. 6d. per cwt.; nitrate of soda 14s. 6d. per cwt.; sulphate of ammonia 10s. per cwt.

The amount of wheat required to meet the cost of 1 cwt. of each of the fertilizers used is approximately as follows: $1\frac{1}{3}$ bushels for 1 cwt. of super; 4 bushels for 1 cwt. of nitrate of soda; 3 bushels for 1 cwt. of sulphate of ammonia.

PARTICULARS OF TRIALS AND YIELDS FROM TREATMENTS.

Particulars of the individual trials and yields from the various treatments are set out in Tables 1 to 9 which follow.

Table 1.—Locations of Trials, Previous History of Field, Variety of Wheat, Rate of Seeding, Date of Sowing of Crop, Date of Nitrogen Application, and Date of Harvesting.

Serial No.	Name.	Address.	Previous History of Field.	Variety of Wheat.	Rate of Seeding per Acre.	Date sown.	Date Nitrogen applied.	Date harvested.
			Type A Experiments.					
					lb.			
1	High School ..	Rangiora, Canterbury ..	1930–31, barley; 1929–30, potatoes; 1928–29, grass	Solid-straw Tuscan	95	2/6/31	24/9/31	20/1/32
2	D. Mulholland ..	Darfield, Canterbury ..	1930–31, rape; 1928–30, grass	Solid-straw Tuscan	100	4/6/31	25/9/31	20/1/32
3	R. T. McMillan ..	Irwell, Canterbury	1926–31, grass	Solid-straw Tuscan	100	29/5/31	5/10/31	19/1/32
4	J. Finlay	Eiffleton, Canterbury ..	1930–31, rape; 1929–30, wheat; 1928–29, peas	Solid-straw Tuscan	90	9/6/31	18/9/31	2/2/32
5	J. O'Grady	Winchmore, Canterbury ..	1930–31, rape; 1929–30, wheat; 1928–29, grass	Solid-straw Tuscan	90	4/6/31	19/9/31	3/2/32
6	L. Fenwick	St. Andrews, South Canterbury	1923–31, grass	Hunter's ..	120	2/6/31	21/9/31	4/2/32
7	J. D. Grant	Awamoa, North Otago ..	1930–31, rape; 1929–30, Western Wolths; 1928–29, oats	Hunter's ..	110	22/5/31	25/9/31	1/2/32
8	R. Dick	Weston, North Otago ..	1920–31, grass	Hunter's ..	90	19/5/31	24/9/31	4/3/32
			Type B Experiments.					
9	H. E. Evans.. ..	Fernside, Canterbury ..	1930–31, rape; 1927–30, grass	Solid-straw Tuscan	100	20/5/31	19/8/31* 29/9/31	11/1/32
10	C. Rands	Springbank, Canterbury ..	1930–31, wheat; 1929–30, turnips; 1928–29, grass	Solid-straw Tuscan	114	18/5/31	19/8/31 29/9/31	7/1/32
11	M. Wilson	Halkett, Canterbury ..	1930–31, wheat; 1929–30, turnips; 1928–29, rape	Solid-straw Tuscan	100	25/5/31	19/8/31 24/9/31	12/1/32
12	T. Pearson	Hororata, Canterbury ..	1926–31, grass	Solid-straw Tuscan	100	11/5/31	19/8/31 25/9/31	22/1/32
13	A. Amos	Wakanui, Canterbury ..	1930–31, lupins (harvested); 1929–30, wheat; 1928–29, peas	Solid-straw Tuscan	110	15/5/31	28/8/31 18/9/31	20/1/32
14	J. Ruddenklau ..	Methven, Canterbury ..	1930–31, wheat; 1926–30, grass	Solid-straw Tuscan	90	2/6/31	28/8/31 23/9/31	1/2/32
15	W. McCully	Geraldine, South Canterbury	1930–31, rape; 1929–30, fallow; 1926–29, grass	Solid-straw Tuscan	105	12/5/31	20/8/31 18/9/31	12/1/32

Table 1—continued.

Serial No.	Name.	Address.	Previous History of Field.	Variety of Wheat.	Rate of Seeding per Acre.	Date sown.	Date Nitrogen applied.	Date harvested.
			Type B Experiments—continued.					
					lb.			
16	A. Barnett	Morven, South Canterbury	1930–31, rape; 1928–30, grass	Hunter's	80	25/5/31	20/8/31* 24/9/31	26/1/32
17	Waitaki Boys' High School	Oamaru, North Otago	1924–31, grass	Hunters	120	26/6/31	3/9/31 24/9/31	11/2/32
18	D. M. Borrie	Papakaio, North Otago	1930–31, wheat; 1929–30, western wolths	Hunter's	102	20/5/31	7/9/31 24/9/31	2/2/32
			Type C Experiments.					
19	F. W. Carpenter	Prebbleton, Canterbury	1930–31, wheat; 1929–30, potatoes; 1928–29, grass	Solid-straw Tuscan	104	22/5/31	(3, 4, 5)† 27/8/31 (6, 7, 8) 23/9/31 (9)28/10/31	15/1/32
20	G. H. Cross	Oxford, Canterbury	1930–31, rape; 1928–30, grass	Solid-straw Tuscan	97	19/6/31	(3 and 4) 21/8/31 (6 and 7) 28/9/31 (9)23/10/31	29/1/32
21	D. Spence	Sherwood, Canterbury	1930–31, wheat; 1927–30, grass	Solid-straw Tuscan	90	17/7/31	(3 and 4) 20/8/31 (6 and 7) 23/9/31 (9)21/10/31	30/1/32
			Miscellaneous Trials.					
22	W. Donald	Amberley, Canterbury	1930–31, turnips; 1927–30, grass	Solid-straw Tuscan	120	8/9/31	With seed	23/1/32
23	Gore Experimental Area	Gore, Southland	1930–31, swedes; 1929–30, oats; 1928–29, turnips	Garnet	181	3/10/31	22/10/31	3/3/32

* The first date indicates the date of application of sulphate of ammonia, the second the date nitrate of soda was applied.
† Figures in brackets represent the treatment numbers (see Table 4) to which manures were applied.

Table 2.—Yields in Bushels per Acre from Different Treatments in Type A Experiments.

Serial No.*	No Manure.	Super 1 cwt.	Super 2 cwt.	Super 1 cwt. + Nitrate of Soda 1 cwt	Super 2 cwt. + Nitrate of Soda 1 cwt.	Super 1 cwt. + Lime 2 cwt.
1 ..	44·9	51·8	53·4	54·2	53·9	53·3
2 ..	16·5	18·6	17·1	16·9	16·8	19·4
3 ..	43·3	45·9	44·2	49·8	50·0	45·2
4 ..	31·2	36·0	35·2	35·4	35·0	35·2
5 ..	12·0	17·4	18·0	16·2	17·0	17·7
6 ..	26·5	30·5	29·3	30·0	29·8	30·4
7 ..	37·9	41·1	40·3	41·9	42·9	43·0
8 ..	27·3	34·6	32·0	33·7	34·3	35·8
23 ..	19·6	†	22·4	..	23·5	..

* See Table 1 for location of trials. † Super 1 cwt. not used. The yields of super 2 cwt. plus sulphate of potash 1 cwt. was 23·0 bushels, and that of super 2 cwt. plus sulphate of potash 1 cwt. plus nitrate of soda 1 cwt. was 23·5 bushels. Owing to bird damage the results of this experiment cannot be regarded as highly reliable. Observations during growth indicated a considerable superiority of super over no manure. Plots to which potash was added appeared to be superior to those having super only, though the figures do not show any marked superiority.

Table 3.—Yields in Bushels per Acre from Different Treatments in Type B Experiments.

Serial No.*	No Manure.	Super 1 cwt.	Super 1 cwt. + Nitrate of Soda 1 cwt.	Super 1 cwt. + Nitrate of Soda 1½ cwt.	Super 1 cwt. + Sulphate of Ammonia 1 cwt.	Super 1 cwt. + Sulphate of Ammonia 1½ cwt.
9 ..	17·9	22·2	19·5	19·1	20·0	21·1
10 ..	22·4	25·2	26·7	26·3	25·6	28·1
11 ..	24·6	28·3	30·4	30·6	28·7	31·4
12 ..	29·4	35·9	36·0	38·0	41·8	39·8
13 ..	42·8	49·1	50·6	50·9	49·9	49·8
14 ..	34·3	42·5	40·3	38·5	42·9	42·9
15 ..	27·8	33·2	33·9	35·7	33·1	35·7
16 ..	30·4	37·0	38·5	40·6	38·7	40·2
17 ..	33·7	46·5	48·0	45·5	45·5	46·6
18 ..	19·0	22·3	21·9	23·4	23·9	23·9
22† ..	5·9	9·0	..	..	8·1	..

* See Table 1 for location of trials. † Spring-sown wheat. Yields of other treatments in this trial are as follows: Super 2 cwt., 10 bushels per acre; super 2 cwt. plus sulphate of ammonia 1 cwt., 9 bushels; super 1 cwt. plus lime 2 cwt. plus sulphate of ammonia 1 cwt., 9·3 bushels.

Table 4.—Yields in Bushels per Acre from Different Treatments in Type C Experiments.

Treatments per Acre.*	Month of Nitrogen Application.	Yields in Bushels per Acre of Experiments, Serial Nos. 19.	20.	21.
(1) Super 1 cwt.	..	45·9	28·5	20·1
(2) Super 1 cwt., plus sulphate of ammonia 1 cwt.	With seed ..	52·1	28·9	23·8
(3) Super 1 cwt., plus sulphate of ammonia 1 cwt.	August ..	50·2	28·0	22·9
(4) Super 1 cwt., plus nitrate of soda 149 lb.	August ..	52·3	30·4	23·6
(5) Super 1 cwt., plus calcium cyanamide 1 cwt.	August ..	46·6	..	..

Table 4—continued.

Treatments per Acre.*	Month of Nitrogen Application.	Yields in Bushels per Acre of Experiments, Serial Nos.		
		19.	20.	21.
(6) Super 1 cwt., plus sulphate of ammonia 1 cwt.	September ..	49·8	29·0	22·0
(7) Super 1 cwt., plus nitrate of soda 149 lb.	September ..	51·1	30·3	24·3
(8) Super 1 cwt., plus calcium cyanamide 1 cwt.	September ..	48·1	..	..
(9) Super 1 cwt., plus nitrate of soda 149 lb.	October ..	50·2	32·4	23·8

* See Table 1 for location of trials.

Analysis of Effects of Manures.

The increases due to treatments are shown in Tables 5 to 8, supplemented by detailed comments.

Table 5.—Differences in Yields in Bushels per Acre between (a) Super 1 cwt. and No Manure; (b) Super 1 cwt. plus Nitrate of Soda 1 cwt. and Super 1 cwt. (Type A, B, and C Experiments).

Serial No.	Increase due to Manures.		Serial No.	Increase due to Manures.	
	Increase of Super 1 cwt. over No Manure.	Increase of Super 1 cwt. + Nitrate of Soda over Super 1 cwt.		Increase of Super 1 cwt. over No Manure.	Increase of Super 1 cwt. + Nitrate of Soda over Super 1 cwt.
1 ..	**6·9**	2·4	12 ..	**6·5**	0·1
2 ..	**2·1**	**−1·7**	13 ..	**6·3**	1·5
3 ..	**2·6**	**3·9**	14 ..	**8·2**	**−2·2**
4 ..	**4·8**	−0·6	15 ..	**5·4**	0·7
5 ..	**5·4**	−1·2	16 ..	**6·6**	1·5
6 ..	**4·0**	−0·5	17 ..	**12·8**	1·5
7 ..	**3·2**	0·8	18 ..	**3·3**	−0·4
8 ..	**7·3**	−0·9	19 ..	..	**5·2***
9 ..	**4·3**	−2·7	20 ..	..	1·8*
10 ..	**2·8**	1·5	21 ..	..	**4·2***
11 ..	**3·7**	**2·1**	22 ..	**3·1**	..
	Average increases		.. ..	5·2	0·8

* In these experiments the September application of nitrate of soda only has been considered for inclusion in the above table, and the amount of nitrate of soda used was 149 lb. per acre.

NOTE.—Figures in heavy type in this and subsequent tables, where such occur, represent statistically significant differences.

Comments on Table 5.

Super 1 cwt.—The average increase due to super 1 cwt. (nineteen experiments) equals 5·2 bushels per acre. The average profit due to super 1 cwt. equals 13s. 8d. per acre. In all experiments super has increased the yield to a significant extent. Up to the season under review the average increase from the use of 1 cwt. super in ninety-one experiments conducted over eight seasons was 4·1 bushels per acre, so that the increase due to super 1 cwt. in the 1931–32 season was above the general average, which latter, including the 1931–32 season, is 4·3 bushels per acre.

Nitrate of Soda.—From the average of twenty-one experiments the increase due to nitrate of soda 1 cwt. (those marked by an asterisk received 149 lb.) was 0·8 bushels per acre. Obviously the dry conditions experienced in the 1931–32 season were unfavourable to response from the use of nitrogen. In the previous season, when pre-harvest weather was also very dry, the average increase for 1 cwt. of nitrate of soda was 2·6 bushels per acre, and even this represented the lowest seasonal average for some years. Nitrate of soda has given significant increases in only four out of twenty-one experiments, and on the basis of 4 bushels of wheat being required to pay for 1 cwt. of nitrate of soda only one experiment shows a paying return. The average loss due to the use of nitrate of soda amounts to 11s. 6d. per acre.

Table 6.—Differences in Yields in Bushels per Acre between (a) Super 2 cwt. and Super 1 cwt.; (b) Super 2 cwt. plus Nitrate of Soda 1 cwt. and Super 1 cwt. plus Nitrate of Soda 1 cwt.; (c) Super 1 cwt. plus Lime 2 cwt. and Super 1 cwt. (Type A Experiments).

Serial No.	Super 2 cwt.: Increase or Decrease in relation to Super 1 cwt.	Super 2 cwt. + Nitrate of Soda 1 cwt.: Increase or Decrease in relation to Super 1 cwt. + Nitrate of Soda 1 cwt.	Super 1 cwt. + Lime 2 cwt.: Increase or Decrease in relation to Super 1 cwt.
1 ..	**1·6**	−0·3	1·5
2 ..	**−1·5**	−0·1	**0·8**
3 ..	−1·7	0·2	−0·7
4 ..	−0·8	−0·4	−0·8
5 ..	0·6	0·8	0·3
6 ..	**−1·1**	−0·2	−0·1
7 ..	**−0·8**	**1·0**	**1·9**
8 ..	**−2·6**	0·6	1·2
Average ..	−0·8	0·2	0·5

Comments on Table 6.

Comparisons between Super 2 cwt. and Super 1 cwt.—The average *decrease* in yield of super 2 cwt. when compared with super 1 cwt. is 0·8 bushels per acre. In only one experiment was super 2 cwt. significantly better than super 1 cwt., but in four experiments significant depressions in yield were recorded. These results confirm findings of previous seasons that in general there does not appear to be any advantage in increasing the quantity of super above 1 cwt. per acre.

Comparisons between Super 2 cwt. plus Nitrate of Soda 1 cwt. and Super 1 cwt. plus Nitrate of Soda 1 cwt.—The average increase of super 2 cwt. plus nitrate of soda 1 cwt. over super 1 cwt. plus nitrate of soda 1 cwt. equals 0·2 bushels per acre. Even when used with nitrogen, on the average the use of the greater quantity of super does not appear to be justified.

Comparison between Super 1 cwt. plus Lime 2 cwt. and Super 1 cwt.—The average increase of super 1 cwt. plus lime 2 cwt. over super 1 cwt. equals 0·5 bushels per acre. In Experiments 2 and 7 the addition of lime has caused significant increases. Experiments 1 and 8 also show fair increases due to lime, though not to a significant extent. During the three seasons in which the addition of lime to superphosphate has

been tried on wheat, nine out of a total of thirty-seven experiments have shown increases of 1½ bushels or more from the use of 2 cwt. of carbonate of lime, the largest increase being 2½ bushels. Generally speaking, these increases have occurred on soils highly deficient in lime, although other soils equally deficient have not given responses. The use of lime as an addition to super sown with wheat cannot be recommended generally, although in some places its use will result in a small profit.

Table 7.—Differences in Yields between (a) Nitrate of Soda 1 cwt. and Sulphate of Ammonia 1 cwt.; (b) Nitrate of Soda 1 cwt. and Nitrate of Soda 1½ cwt.; (c) Nitrate of Soda 1½ cwt. and Sulphate of Ammonia 1½ cwt. (Type B Experiments).

(All treatments received 1 cwt. of super in addition to nitrogenous fertilizers)

Serial No.	Nitrate of Soda 1 cwt.: Increase or Decrease in relation to Sulphate of Ammonia 1 cwt.	Nitrate of Soda 1½ cwt.: Increase or Decrease in relation to Nitrate of Soda 1 cwt.	Nitrate of Soda 1½ cwt.: Increase or Decrease in relation to Sulphate of Ammonia 1½ cwt.
9 ..	−0·5	−0·4	**−2·0**
10 ..	+0·9	−0·4	**−1·8**
11 ..	**+1·7**	+0·2	−0·8
12 ..	**−5·8**	+2·0	−1·8
13 ..	+0·7	+0·3	+1·1
14 ..	**−2·6**	**−1·8**	**−4·4**
15 ..	+0·8	**+1·8**	0·0
16 ..	−0·2	**+2·1**	+0·4
17 ..	−2·5	−2·5	−1·5
18 ..	**−2·0**	**+1·5**	−0·5
Average ..	−0·95	0·3	−1·1

Comments on Table 7.

Comparisons between Nitrate of Soda 1 cwt. and Sulphate of Ammonia 1 cwt.—In one experiment (No. 11) nitrate of soda 1 cwt. is significantly better than sulphate of ammonia 1 cwt., and in three experiments (Nos. 12, 14, and 18) sulphate of ammonia 1 cwt. is the better. The average difference in favour of sulphate of ammonia 1 cwt. is 0·95 bushels per acre. In fourteen trials in which sulphate of ammonia 1 cwt. was used the average increase of sulphate of ammonia 1 cwt. plus super over super alone was 1·0 bushels per acre. In five of these trials the increases due to sulphate of ammonia were significant, but in only three of these were the increases payable. The average loss due to the use of sulphate of ammonia 1 cwt. amounts to 6s. 6d. per acre.

NOTE.—It must be remembered that sulphate of ammonia contains 20·6 per cent nitrogen and nitrate of soda 15·5 per cent., so that the sulphate of ammonia supplies practically one-third more nitrogen than nitrate of soda.

Comparisons between Nitrate of Soda 1 cwt. and Nitrate of Soda 1½ cwt.—The use of the higher quantity of nitrate of soda has resulted in an average increase of 0·3 bushels per acre.

Comparisons between Nitrate of Soda 1½ cwt. and Sulphate of Ammonia 1½ cwt.—When these two are compared the average difference in favour of sulphate of ammonia 1½ cwt. is 1·1 bushels per acre. In

three experiments this superiority is significant, whereas no significant differences are shown in favour of the nitrate of soda.

Table 8.—Increases in Bushels per Acre over Super alone of Super plus Nitrogenous Fertilizers applied at Different Times, in Bushels per Acre.

Fertilizer and Quantity per Acre.	Month of Application.	Increases in Bushels per Acre in Experiments, Serial Nos. 19.	20.	21.
Sulphate of ammonia 1 cwt.	With seed*	6·2	0·4	3·7
	August	4·3	−0·5	2·8
	September	3·9	0·5	1·9
Nitrate of soda 149 lb.	August	6·4	1·9	3·5
	September	5·2	1·8	4·2
	October	4·3	3·9	3·7
Calcium cyanamide 1 cwt.	August	0·7	..	..
	September	2·2	..	..
Standard error		0·701	0·695	0·260

* For dates of sowing seed, see Table 1.

Any differences in yield greater than three times the standard error are statistically significant.

Comments on Table 8.

General Effect of Nitrogenous Manures.—In Experiment serial No. 19 all nitrogenous dressings, with the exception of calcium cyanamide (August), gave significant increases over super alone. In Experiment 20 only one treatment (nitrate of soda applied in October) has given a significant increase, while in Experiment 21 all nitrogenous dressings gave significant increases. Calcium cyanamide, which caused foliage of crop to yellow after application, has been the least effective; taken on the whole, nitrate of soda has been slightly more effective than sulphate of ammonia. It should be remembered, however, that equivalent quantities of nitrogen were applied, so that 149 lb. nitrate of soda was applied in these experiments, whereas in the Type B experiments equivalent quantities of sulphate of ammonia and nitrate of soda were applied, with results on the average in favour of the sulphate of ammonia.

TIME OF APPLICATION OF SULPHATE OF AMMONIA AND NITRATE OF SODA.

(1) Sulphate of Ammonia.—In two experiments the early applications of sulphate of ammonia with the seed gave the largest increases in yield. In Experiment 21 sulphate of ammonia with the seed was significantly better than the August or September applications, and in Experiment 19 the application with the seed was significantly better than the September dressing and almost significantly better than the August dressing. In Experiment 20 no significant differences were recorded, nor was there any definite trend as in the other two trials.

(2) Nitrate of Soda.—Except in the case of Experiment 19, there are no significant differences between the yields from nitrate of soda

applied at different times; in fact, the greatest increases due to it resulted from applications in different months in the three experiments.

(3) Comparison of Results in Season 1931–32 with those of Seasons 1929–30 and 1930–31.—In order that comparisons may be made between results of the Type C trials summarized above and similar trials conducted previously, the increases given over the control (super only) plots by sulphate of ammonia and nitrate of soda applied at different times in trials carried out during the 1929–30 and 1930–31 seasons are given in Table 9. The average increases for the whole of the seven trials carried out to date are also given.

Table 9.—Summary of Increases over Control (Super 1 cwt.) Plots of Sulphate of Ammonia and Nitrate of Soda applied at Different Times from Experiments 1929–30 and 1930–31, and Average Increases from All Type C Experiments conducted to Date (1931–32).

Treatment per Acre.	Time of Application.	Increases in Bushels per Acre in Type C Experiments as indicated.				Average Increases‡ over Control in Seven Trials to Date.
		F. W. Carpenter, Prebbleton, 1929–30 *	F. W. Carpenter, Prebbleton, 1930–31.†	C. M. Talbot, Tycho, 1930–31.†	J. R. McCulloch, Ngapara, 1930–31.†	
Sulphate of ammonia 1 cwt.	August ..	9·3	3·4	2·8	2·0	3·4
	September	7·4	3·6	3·5	2·7	3·3
	October..	5·5	1·7	2·6	2·5	(4 trials only)
Nitrate of soda 149 lb.	August ..	8·5	6·2	1·8	3·6	4·5
	September	10·8	6·2	5·0	3·5	5·2
	October	10·7	4·0	5·4	5·0	5·3

* *Journal*, March, 1931, page 185. † *Journal*, July, 1931, page 46. ‡ Including results from Table 8.

From the general average this table indicates that the earlier applications of sulphate of ammonia and later applications of nitrate of soda have been the most successful. Although there is not a great difference between August and September dressings of sulphate of ammonia, the marked success of the latter applied with the seed during the 1931–32 season and the inferiority of October dressings in the 1929–30 and 1930–31 seasons suggest that sulphate of ammonia may give the best results when applied at seeding-time. It must be kept in mind, however, that the one season in which the application with the seed has been tried was abnormally dry in the spring and summer.

SUMMARY AND GENERAL CONCLUSIONS.

The results of twenty-three experiments on the manuring of wheat in the South Island conducted in the 1931–32 season are given. The effects on yield of superphosphate, super plus lime, nitrate of soda, and sulphate of ammonia are analysed, and the relative effects of applying nitrate of soda, sulphate of ammonia, and calcium cyanamide at different time are discussed. The outstanding features are as follows:—

The average increase (5·2 bushels per acre) resulting from the use of superphosphate 1 cwt. was above the nine-year average (4·3 bushels per acre), while the average increases from nitrate of soda or sulphate

of ammonia were the lowest recorded in the last four seasons, during which time experiments have been fairly widely distributed.

In every experiment 1 cwt. superphosphate gave significant and payable results. Super at 2 cwt. per acre, however, gave, on the average, returns slightly below those of super 1 cwt. While the use of 1 cwt. super is strongly recommended, the evidence to date tends to discourage the recommendation of a greater quantity.

The use of lime as an addition to super cannot be advocated generally, although small profits resulted on some soils highly deficient in lime.

The good average results secured from nitrogen in the seasons 1927–28 and 1928–29 have not been repeated in the past two seasons. Both the latter were characterized by extremely dry pre-harvest conditions, and were so abnormal in this respect as to justify the conclusion that the climatic conditions were chiefly responsible for the poor effects from the use of nitrogen. The average effect over a large number of seasons can be determined only by continuing the present series of investigations. September and October have been in the main the best months for applying nitrate of soda, while August applications of sulphate of ammonia have proved better on the average than dressings applied later. The application of sulphate of ammonia with the seed gives promise of being the most successful, but until further trials have been conducted nothing definite can be stated.

The Department extends its thanks to those farmers who provided land for carrying out the experiments.

The field-work in connection with the experiments was carried out under the direction of Mr. R. McGillivray, Fields Superintendent, Christchurch, by Instructors G. G. Calder, Christchurch, E. M. Bates, Ashburton, W. Stafford, Timaru; and under the direction of Mr. R. B. Tennent, Fields Superintendent, Dunedin, by Instructor T. A. Sellwood, Oamaru, and W. Sleeman, Overseer, Gore Experimental Area.

—*A. W. Hudson, Crop Experimentalist, Plant Research Station.*
—*J. W. Woodcock, Assistant Crop Experimentalist.*

SUPERPHOSPHATE IN THE DRINKING-WATER FOR CATTLE.

A NUMBER of inquiries have been received with reference to the proportions of superphosphate and water to be used in giving cattle phosphate in a water-soluble form for supplementing a deficiency of phosphate, and perhaps also of calcium, in the food-supply in cases where it is impracticable to use enough super for top-dressing, or even when none at all can be used.

The proportions which have been found practicable to give in this way are 1 lb. of superphosphate in 100 gallons of soft drinking-water. Cattle will drink this readily enough when no other source of supply is available, but when puddles abound in the paddock no guarantee can be given that they will not forsake the medicated water for a time.

It should be noted that soft water is specified, as hard water which contains lime would tend to throw out of solution the valuable soluble phosphate.

—*B. C. Aston, Chief Chemist, Department of Agriculture.*

EFFICIENT NESTING CONDITIONS FOR FOWLS.

A NEW TYPE OF NEST RACK.

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THERE are certain essentials required in nesting arrangements for fowls which the nondescript makeshift type of nest commonly provided on the average poultry plant does not conform to. Under such conditions the nests rapidly become breeding-grounds for red mite and other parasitic vermin, resulting in increased costs and a depleted egg-yield.

In view of the requirements of nesting facilities, it is difficult to entirely dispense with wood for construction purposes, hence the necessity for avoiding as far as possible joints or crevices wherein parasitic pests may take up their quarters. The materials used for nesting should be capable of being easily dismantled in order to facilitate cleaning and disinfection, otherwise sooner or later infestation of quarters is almost sure to result.

In an endeavour to meet the problem poultry-keepers have used empty petrol-tins cut down as nests. Changing methods in the distribution of petrol supplies, however, have largely eliminated this source of supply and raised the question of substitutes for the purpose. The tins, while useful, being practically vermin-proof, possess certain disadvantages in that they are rather small, and, having hard bottoms, have never filled the requirements of the ideal nest. Apparently the fowls dislike the hard tin bottoms, as evidenced by their restlessness in settling down. In an endeavour to overcome this natural dislike to artificial conditions, sawdust or sand have been used for nesting materials with more or less success.

Associated with the use of petrol-tin nests is the unavoidable occurrence of several hens endeavouring to use the nest at the same time. In the ensuing struggle for possession any eggs that may be present in the nest are liable to become broken, and this is often the forerunner to an outbreak of the objectionable habit of egg-eating. Soft-shelled and broken eggs in the nests are always a source of trouble, even if only in the fouling of nest and material, and the resulting washing required before the remaining eggs are in a fit condition to market.

The writer is of the opinion that in commercial practice, where the natural instinct displayed by the hen on range in seeking solitude for nesting can only be complied with to a small extent, it is a much sounder policy to make the nests large enough to readily accommodate two or perhaps three birds at the same time. The limited space, coupled with the inclination of hens kept under artificial conditions to seek joint occupation of nests, has at times been responsible for the vice of vent picking, which if unchecked often leads to a worse trouble —cannibalism—becoming established.

Unable to secure sufficient comfortable nesting space, the interloper will eventually lay her egg in full view of other birds, which may be on the running-boards fronting the nests. While so doing there is

the temptation for other birds to pick at the fleshy vent, often with fatal consequences. If such troubles are to be prevented, the factor of seclusion is of paramount importance in the arrangement of the nests.

With the continued improvement of our strains of fowls from an egg-laying viewpoint, and the constant endeavour to increase the size of eggs, slight hæmorrhages due to minor ovary and oviduct troubles are apt to make their appearance, and these, if not provided against as before stated, may result in unnecessary loss of stock.

The Nest Rack described.

An effort has been made to solve or control in part the difficulties that have been mentioned by means of the nest rack, designed by the writer, shown in the accompanying illustrations.

Briefly stated, the requirements of the ideal nest are as follows: (1) Seclusion from the members of the flock, other than for laying purposes; (2) sanitary construction, allowing of easy dismantling for cleaning and disinfecting; (3) capacity for being closed up when not required for nesting purposes; (4) possession of a bottom which will mitigate against the possibility of cracked eggs due to contact with a hard substance; (5) ease of manipulation for the gathering of eggs by the attendant. These several factors are provided for, and the nest rack offers a cheap, practical, and efficient way of meeting the essentials referred to. The rack has been constructed largely of wood for the sake of convenience, but is capable of being made from angle iron for supports and framing, with sheet iron for doors and partitions of nests.

The natural instinct of the hen to seek seclusion in her nest is encouraged and met by providing entrances to the nests from a running-board at the back of the rack, and facing either the side or front walls of the house. Further seclusion is secured by keeping the floor of the nests 5 in. below the level of the running-board, which, in effect, keeps the occupant well below the range of interference. The running-board is hinged to the rack by reversing the position of the hinges—that is, by screwing them on upside down. The hinges then act as locks and supports for the running-board. If further support is deemed advisable, a right-angle support screwed on to the board will serve the purpose.

When not required to admit the birds to the nests, the boards may be raised to a perpendicular position, thus presenting a barrier to entrance. Facilities for this purpose provide a much-needed practical aid during the moulting season, when many sparsely feathered birds seek the extra shelter of the nests, with spoiling effect on the nest material and eggs alike.

In introducing the principle of joint occupation of nests, the writer has chosen the lesser difficulty in view of the hen's natural tendencies when housed in flocks under semi-intensive conditions. As a general rule, the last occupant will quietly gather any eggs present under herself, leaving ample room, and obviating any cause for fighting to secure possession of the nest.

There appears to exist in fowls a natural aversion to hard conditions under foot, for whenever given the opportunity under free range conditions they will invariably seek a soft secluded spot in which to

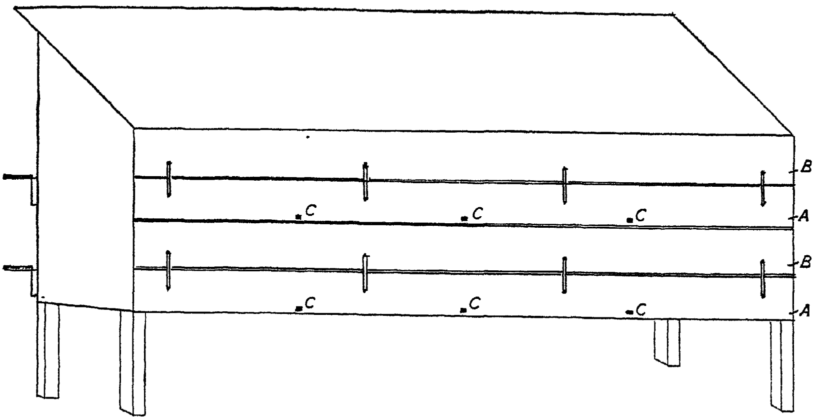

FIG. 1. THE NEST RACK, SHOWING DOORS FOR GATHERING EGGS CLOSED, RUNNING BOARDS IN POSITION, AND NESTS OPEN.

make their nest. This tendency has been provided for by using ½-in.-mesh wire-netting for nest-bottoms, with straw as nesting material. In effect, this should largely remove the necessity for so many eggs requiring to be cleaned before being in a fit condition to market. No doubt hard nest-bottoms are largely responsible for many cracked and stained eggs. In addition, the use of netting will ensure that if by chance an egg becomes broken or fouling of the nest take place there is at least some possibility of the offending matter finding its way through the netting and out of the nest.

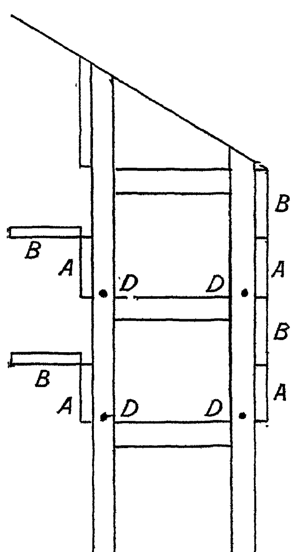

FIG. 2. CROSS-SECTION OF FIG. 1.

The wire-netting forming the floor is threaded on to iron bolts, punctuated at three 20-in. spaces with eye-holes through which the cross bolts also threaded pass, and are secured on the inside and outside of the racks by nuts. See points marked "C" in Fig. 1, and "C" and "D" in Fig. 4. The ends are secured by staples to the end braces.

It will be necessary when constructing the rack to assemble the floor, and place it in position before screwing on boards "A" and "B," otherwise difficulty will be experienced in assembling the rack. Conduit or small calibre water-piping will serve for longitudinal bolts, with heavy fencing wire for cross bolts, if a cheaper method of construction is desired.

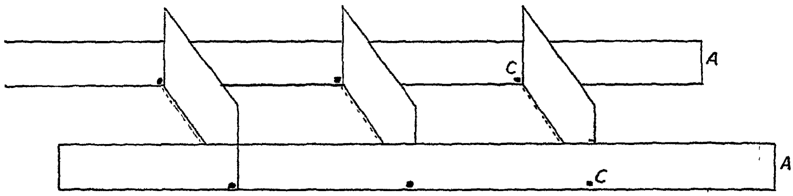

FIG. 3. SHOWING METHOD OF ASSEMBLING THE NEST PARTITIONS (CROSS BOLTS ONLY).

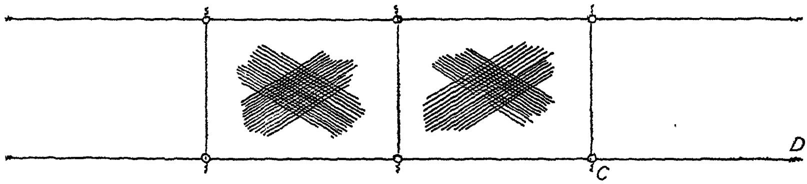

FIG. 4. SHOWING LONGITUDINAL AND CROSS BOLTS, AND WIRE-NETTING FLOOR CONSTRUCTION.

Fig. 3 shows the method of assembling the nests and the partitions of heavy sheet iron or asbestos slate. A rabbeted ¼-in. groove is cut at 20-in. spaces on the inner side of boards marked " A," in Figs. 1, 2, and 3, in which the partitions sit. The partitions should be sufficiently high to prevent birds gaining access to nests other than the one entered. Neglect of this essential detail may result in quarrelling and subsequent damage to eggs. Obstructions over which it is possible for a hen to scramble without using her wings as a natural propelling or lifting force are also responsible for some of the ovarian accidents and troubles experienced on poultry plants. In this connection, the top tier of nests in the rack will need a ceiling of wire-netting on a level with the top of the partitions, to counter the increased depth under the sloping roof.

Eggs are gathered from the doors marked " B " in Fig. 1, which are similar in all respects, including method of hinging, to those appearing as running-boards on the opposite side of the rack as shown in Fig. 2. The construction is the same, the only difference being that one board serves as an entrance to the nests when in a horizontal position. When closed, both sides of the rack are similar. Boards " A " and " B " are screwed to the frame to facilitate dismantling.

The construction of the rack does not preclude its use for the purpose of trap-nesting. It is still possible to use the system of traps illustrated in the Department's Bulletin 66, " Utility-poultry Keeping," by closing the usual running-boards, and making the entrance to the nests from the opposite side of the racks. The boards previously doing duty as egg-gathering doors would then become running-boards for entrance to the nests. Extra provision would be needed to carry the additional weight of the traps and the extra running-board required.

The roof and sides of the rack are best constructed of asbestos slate, to facilitate cleaning and sanitary requirements. If desired, a further

tier of nests may be included in the rack without impairing its usefulness; in fact, it can be made to suit any special requirement.

Material used in the construction of the rack is as follows: 2 in. by 2 in. for legs and braces; four boards 6 ft. 8 in. long by 5 in. by 1 in.; four boards 6 ft. 8 in. long by 6 in. by 1 in.; four iron rods or bolts with eye-holes at 20 in. spaces, 6 ft. 9 in. long by $\frac{3}{8}$ in.; six iron bolts 16$\frac{3}{4}$ in. long by $\frac{1}{4}$ in. All bolts to be threaded at both ends, with two nuts at each end.

This nesting rack is being installed at the Wallaceville Poultry Station.

SOME ECONOMIC PHASES OF APPLE PRODUCTION IN NEW ZEALAND.

(Concluded.)

D. A. VIGGERS, Farm Economics Section, Department of Agriculture.

REPLACEMENTS.

REPLACEMENT is a phase of orchard management which merits very close attention, for by having to choose from a multiplicity of varieties an orchardist may be in grave doubts as to when he has made a wise choice. Varieties planted present practically a static condition, for once the trees are established they are certain to remain for a number of years. It is because of this static character that the orchardist should be very careful in selection, as, once planted, he can only improve management by extending his knowledge concerning those specific varieties or subsequently reworking the trees if proved a failure.

Selection is a very complex problem. On the one hand there are the characteristics of climate to be considered, and on the other hand the demands of the consumer, while in between are the difficulties of management and intricacies of marketing. In so far as this survey is concerned, it is possible to touch only the fringe of this subject; but mention will be made of some possibilities in this direction, together with what slight details the study affords.

Varietal Characteristics.—Climate controls selection of varieties to a fairly extensive degree, and though wide elasticity exists in choice for a district as a whole a wise choice narrows the field still more, while the numbers available for an individual grower are lessened again. Table 11 shows the proportions of the nineteen leading varieties in the different districts. In reading this table one must be careful, if possible, to distinguish between the popularity for a variety among the growers in a district and the predominance due to survival of the fittest.

A study of the table indicates that as one passes from north to south Sturmer and Jonathan increase in predominance until the South Island is reached, when the proportions do not vary much. Dougherty, on the other hand, shows a preference in the more Northern districts, as also does Gravenstein. Rome Beauty and varieties of lower proportions show a distinct tendency for popularity in the South.

Table 11.—Percentages of Different Varieties (all Ages) in each District.

Variety.	North Auckland.	Waitemata.	Thames.	Waikato.	Gisborne.	Hawke's Bay.	Wairarapa.	Manawatu.	Nelson.	Mapua-Tasman.	Motueka.	Marlborough.	Christchurch.	Southern Coastal.	Tuapeka.	Vincent.	Total.
Sturmer	0·6	0·8	5·3	12·2	18·7	28·0	38·5	29·5	38·3	26·4	36·3	29·1	30·0	24·8	20·7	22·1	24·3
Delicious	41·5	37·4	16·6	26·4	24·5	18·2	8·2	25·3	14·6	17·7	22·6	21·6	14·0	19·9	13·1	22·2	20·4
Jonathan	1·0	5·2	3·3	9·8	8·3	8·7	28·9	6·3	18·2	19·6	9·7	19·7	14·6	8·2	18·2	18·2	14·3
Cox's Orange Pippin	1·2	4·3	3·5	2·6	11·3	7·3	5·5	3·9	6·1	11·6	4·5	7·7	10·0	6·2	9·0	6·5	7·8
Dunn's	2·0	7·0	5·0	2·9	5·5	2·1	11·2	1·6	5·6	8·3	9·5	5·0	3·5	0·8	4·0	2·4	5·8
Dougherty	32·0	2·2	4·6	1·4	3·1	9·2	..	..	1·4	0·9	2·3	0·6	..	..	..	0·2	3·2
Granny Smith	6·4	7·9	10·5	8·4	3·9	3·9	2·0	0·6	1·4	1·7	4·3	..	0·2	..	0·5	0·5	2·7
Statesman	4·8	1·3	..	4·0	3·0	1·8	0·0	1·9	2·7	4·8	1·3	0·4	1·1	4·1	3·1	1·3	2·7
Gravenstein	2·0	9·1	0·7	15·7	1·1	4·0	..	1·3	0·4	2·1	0·1	0·2	0·0	0·3	0·3	0·1	2·4
Ballarat	1·8	6·1	9·3	2·9	15·1	5·7	1·1	2·2	..	0·2	0·1	2·2	2·3	12·6	0·7	0·3	2·2
Rome Beauty	0·1	1·3	2·8	..	..	2·2	0·9	1·5	0·5	0·9	..	1·3	1·3	0·7	3·9	2·6	1·4
Lord Wolseley	..	0·0	..	0·4	..	1·0	0·0	1·6	1·7	0·0	0·0	0·1	9·7	11·1	1·9	0·4	1·4
Cleopatra	..	0·1	1·3	..	..	0·7	1·1	..	0·5	0·1	0·2	..	..	0·5	6·9	8·6	1·2
Washington	..	..	..	0·5	..	0·7	..	18·0	0·7	0·6	3·2	..	..	0·1	..	..	0·7
Worcester Pearmain	..	..	..	..	..	0·1	0·3	0·4	0·2	1·4	0·9	1·4	2·1	2·1	0·2	..	0·7
London Pippin	..	0·4	2·0	0·6	..	0·0	..	..	0·9	0·8	1·9	2·9	0·4	0·2	0·1	2·3	0·7
Tasma	..	0·0	..	..	..	..	..	..	1·3	0·3	1·2	1·5	1·5	0·2	1·5	1·0	0·6
Scarlet Nonpareil	..	..	0·7	..	..	..	..	..	..	..	0·0	..	1·4	0·4	4·0	1·9	0·6
Newtown Pippin	..	..	..	..	..	0·0	..	..	..	0·2	0·2	..	0·7	..	3·9	0·1	0·5
Other varieties	6·6	16·9	34·4	12·2	5·5	6·4	2·3	5·9	5·5	2·4	1·7	6·3	7·2	7·8	8·0	9·3	6·4
Total	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0

If reference is now made to Table 14, the average yields for the mature groups (fourteen years old and over) will confirm this incidence of popularity. Owing to the different levels of production for different districts, it is necessary to remove district effect by choosing a variety that is common to all districts and comparing varieties within districts to that variety. Delicious is suggested as a basis for such a comparison, as the proportions in each district do not vary widely; moreover, it is a very popular variety, averaging 20·4 per cent. of the New Zealand total.

Wise choice necessitates a consideration of soil, a suitable distribution of maturity dates to distribute picking and work dependent on picking, and the inter-relationship of varieties for pollination purposes. Factors such as irregularity of bearing and rate of maturity should be considered, but as yet little is known concerning them. Owing to the large number of trees in Mapua-Tasman in the mature group it has been possible to calculate measures of the variability in yield of seven prominent varieties. Six varieties have all been compared to the seventh—Sturmer—and, so that the results would be strictly comparable, only those orchards appear in Sturmer which also appear for the others. For example, of the sixteen orchards used for Worcester Pearmain the same sixteen were used for the corresponding Sturmers. The results are shown in Table 12.

Table 12.—Average Yield, Deviation of Yield from Average, and Co-efficient of Variability for some Orchards in Mapua-Tasman.

Variety.	Number of Orchards.	Variety under Observation.			Sturmer.		
		Average Yield.	Standard Deviation.	Co-efficient of Variability.	Average Yield.	Standard Deviation.	Co-efficient of Variability.
				Per Cent.			Per Cent.
Dunn's ..	51	1·74±0·10	1·07±0·07	61·4±5·4	2·15±0·09	0·94±0·06	43·6±3·4
Cox's Orange Pippin	52	1·35±0·08	0·82±0·05	60·4±5·3	2·12±0·09	0·91±0·06	43·1±3·3
Delicious ..	50	1·81±0·10	1·01±0·07	56·0±4·8	2·18±0·09	0·96±0·06	44·1±3·5
Statesman ..	24	2·75±0·17	1·25±0·12	45·3±5·2	2·29±0·11	0·83±0·08	36·5±4·0
Worcester Pearmain	16	1·64±0·12	0·71±0·08	43·0±6·0	2·16±0·14	0·80±0·10	37·3±5·4
Jonathan ..	62	1·99±0·10	1·05±0·06	52·7±4·0	2·13±0·08	0·98±0·06	46·1±3·3

NOTE.—The figures following the ± (plus-minus) sign indicate the range within which the chances are equal for those results to fall within or without the above results if this study were undertaken again under the same conditions.

The term "standard deviation" indicates the variation of a yield around the average, but as one cannot compare these deviations because the averages vary, the co-efficient of variability is used which is the standard deviation expressed as a percentage of the average yield. As the co-efficients of variability for Sturmers vary, it is necessary to eliminate this effect; this has been obtained by expressing the co-efficient of variability of the variety under observation as a percentage of the corresponding co-efficient for Sturmers. The result is seen in Table 13.

Table 13.—Variability of Six Varieties compared with Variability in Sturmers.

Variety	Index of Variability.
Sturmer	100
Jonathan	114
Worcester Pearmain ..	115
Statesman	124
Delicious.	127
Cox's Orange Pippin ..	140
Dunn's	141

Variability is a matter of degree; the foregoing table indicates that Cox's Orange Pippin and Dunn's vary more than 40 per cent. and 41 per cent. respectively than do Sturmers. To the orchardist this is a point of great importance, for, while over a large collection of samples an average tends to a constant amount, in the individual case variation is wide. Thus in comparing yields of single trees or small groups it is clearly not right to compare the on-year of one tree or variety with that of the off-year of another; it is an average over several years, allowing for maturity, that should be considered.

The causes of this variability are difficult to determine. That some may be adduced to differences between orchards is seen in Table 12, where the variability amounts to about 7 per cent. between the Sturmers corresponding to Worcester Pearmain and Statesman and the Sturmers corresponding to the remainder. Irregular bearing and biennial bearing, too, are factors exerting an influence, a fact revealed in Cox's Orange and Dunn's. Another factor is that of pollination. Because of the high efficiency of pollination of some and the low efficiency of others, the tree organization of an orchard, in so far as relationship between different varieties is concerned, undoubtedly has an influence worthy of deep consideration. But because a variety may show great variability that is not sufficient reason to discard it, as other factors may more than compensate for this. While there is an undoubted advantage in having varieties which bear consistently, it should be borne in mind that over a series of years, or even every second year, an average yield will be struck. It is the average yield that matters most.

Table 14 serves to indicate the level of maximum production—that is, the quantity of fruit a tree produces when at the height of its productive powers. It seems reasonable to believe that the level of maximum production is a direct indication of the total quantity of fruit a variety can produce. Therefore this table should be of great value, with existing knowledge, in determining what varieties to choose.

Marketing Factors.—The transport and storage qualities of the fruit must be considered; though for most varieties with the advance in technique of cool storage this factor may be reduced to a point where it can be neglected for practical purposes.

Table 14.—Average Production in Mature Groups (Fourteen Years Old and Over) used as an Indication of the Level of Maximum Production for the more Important Varieties in different Districts.

Variety.	North Auckland.			Waitemata.			Hawke's Bay.			Nelson.			Mapua-Tasman.		
	Yield.	Orchards.	Trees.	Yield.	Orchards.	Trees.	Yield.	Orchards.	Trees.	Yield.	Orchards.	Trees.	Yield.	Orchards.	Trees.
Sturmer	..	..	..	1·52	6	196	4·46	35	7,588	2·22	14	5,287	2·20	70	35,261
Delicious	1·73	3	1,402	2·58	19	3,998	4·63	25	4,380	1·56	14	3,441	1·78	52	16,621
Jonathan	..	..	..	2·05	11	1,308	3·13	46	5,288	2·02	18	5,576	2·01	69	26,777
Cox's Orange Pippin	..	..	..	1·96	6	210	3·13	13	837	1·41	4	343	1·30	53	15,486
Dunn's	..	..	..	3·57	19	2,060	4·39	34	1,359	1·30	11	1,424	1·85	56	12,681
Dougherty	1·94	9	6,111	1·27	9	634	4·54	45	4,511	..	..	..	1·82	13	798
Granny Smith	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Statesman	..	..	..	..	..	..	..	..	..	2·51	5	517	2·98	22	3,899
Gravenstein	..	..	..	2·39	22	2,327	5·67	18	1,110	..	..	..	1·95	11	1,438
Ballarat	..	..	..	3·32	6	541	6·67	16	805	..	..	..	..	..	..
Rome Beauty	..	..	..	2·84	5	160	6·32	21	783	..	..	..	2·19	7	1,259
Lord Wolseley	..	..	..	..	..	..	5·64	14	689	.	..	..	..	..	..
Cleopatra	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Washington	..	..	..	..	..	..	..	..	..	..	..	..	2·69	5	439
Worcester Pearmain	..	..	..	..	..	..	..	..	..	..	..	..	1·63	18	2,195
London Pippin	..	..	..	..	..	..	..	..	..	..	..	..	1·97	10	1,428
Tasma	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scarlet Nonpareil	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Newtown Pippin	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

(Continued on next page.)

Table 14—continued.

Variety.	Motueka.			Marlborough.			Christchurch.			Southern Coastal.			Tuapeka.			Vincent.		
	Yield.	Orchards	Trees.	Yield.	Orchards	Trees.	Yield.	Orchards	Trees.	Yield.	Orchards	Trees.	Yield.	Orchards	Trees.	Yield.	Orchards	Trees.
Sturmer	2·34	26	10,708	1·80	10	3,544	2·01	23	5,870	1·96	6	1,088	1·58	11	5,598	0·53	15	4,064
Delicious	2·16	16	3,487	1·55	8	2,103	1·58	12	1,871	1·82	4	814	2·26	8	3,232	1·19	10	1,685
Jonathan	2·54	20	4,715	1·29	10	4,011	2·31	26	4,628	..	..	..	1·98	14	7,652	0·59	14	2,204
Cox's Orange Pippin ..	1·96	13	1,844	..	..	..	0·84	17	2,593	..	..	..	0·72	9	1,549	..	..	..
Dunn's	2·36	22	4,635	2·60	5	703	2·53	5	538	..	..	..	1·72	10	2,243	1·41	6	411
Dougherty	2·51	4	695	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Granny Smith	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Statesman	2·92	4	688	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gravenstein	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ballarat	..	..	..	..	..	..	2·17	6	464	1·41	2	1,042	..	..	..	..	..	..
Rome Beauty	..	..	..	..	..	..	1·89	8	449	..	..	..	3·05	5	1,631	..	..	..
Lord Wolseley	..	..	..	..	..	..	1·89	14	2,491	1·48	3	1,148	..	..	..	..	..	..
Cleopatra	..	..	..	..	..	..	..	..	..	..	..	..	2·10	11	2,222	0·78	8	996
Washington	3·81	4	937	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Worcester Pearmain ..	1·84	6	363	..	..	..	4·91	9	696	..	..	..	..	..	..	..	..	..
London Pippin	2·61	5	419	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tasma	..	..	..	..	..	..	1·68	4	509	..	..	..	..	..	..	..	..	..
Scarlet Nonpareil	..	..	..	..	..	..	1·11	4	712	..	..	..	1·93	5	1,509	..	..	..
Newtown Pippin	..	..	..	..	..	..	..	..	..	..	..	..	1·80	5	1,552	..	..	..

The intricacies of the price-levels, too, should be considered, though they are one of the most fickle factors of all to determine. In Table 15 an attempt has been made to show the relative values of different varieties over a period of five years on the London market. These averages make no allowance for time of arrival, and are weighted by quotations, but unweighted by years.

Table 15.—Average of Quotations of Fifteen Different Varieties on London Market over Five Years

Variety.	Quotation in Shillings.	Variety.	Quotation in Shillings.
Cox's Orange Pippin ..	18·49	Rome Beauty	13·60
Granny Smith	18·12*	Sturmer	13·24
Tasma	14·65	Jonathan	13·16
Cleopatra	14·39	Delicious	13·14
Statesman	14·37	Dunn's	12·67
Dougherty	14·24	Lord Wolsely	12·32
Ballarat	14·13*	London Pippin ..	11·96
Worcester Pearmain ..	13·79*		

* Only four years' quotations available.

This table is based on weekly quotations, and, though it serves to indicate the relative importance now, the position may be greatly altered in a few years' time; an increase in supply, a change in consumers' demands, or an alteration in the proportions of varietal quantities required for definite purposes, are factors which may be responsible for a change in relative values. Further, the relative value of varieties on other markets differ as their particular requirements vary.

How varieties conform to consumers' requirements is a question of great moment. In the long-run, if competition is keen, the consumer by discrimination between prices and varieties will force the grower to plant those types favourable to the consumers' requirements. This necessitates a study of factors which operate on the consumer, consciously or unconsciously, in determining what apples he purchases. Studies in consumers' demands in Michigan (H. P. Gaston) indicate that quality and appearance are of prime importance in that order. A buyer will purchase first on appearance, distinct and definite preference being shown for bright-red fruit, and if appearance is indicative of quality, sales continue, but if quality is poor consumers seek their fruit elsewhere; thus, while appearance guides the first choice, the quality of that first choice determines where the second will be. But one must remember that different consumers, and hence different markets, have different requirements. Research not only into the requirements of the consumers on all markets, but also into what those consumers do not want, is important for the progressive orchardist in connection with his replacement programme.

Activity in Replacement.—Table 16 gives an indication of the present activity in replacement. This table defines the present trend in the popularity of varieties, while Table 11 shows the trend as it appears over a long period of years modified by other influences. Sturmer and Delicious hold sway now and will continue to do so for some years, despite the high proportion of Cox's Orange Pippin and Granny Smith

being planted, as the proportion of these in the New Zealand aggregate, compared with Sturmer and Delicious, is small.

Table 16.—Plantings by Varieties and Districts of Trees under Five Years Old.

Variety.	North Auckland.	Waitemata.	Thames.	Waikato.	Gisborne.	Hawke's Bay.	Wairarapa.	Manawatu.
Sturmer	..	134	..	672	50	3,859	428	170
Delicious	525	2,213	50	530	228	1,695	184	99
Jonathan	..	480	..	87	30	708	100	..
Cox's Orange Pippin ..	164	2,185	71	163	145	4,399	100	21
Dunn's	5	727	..	157	..	257	..	..
Dougherty	45	145	40	..	25	69	..	..
Granny Smith ..	1,103	5,162	360	718	114	3,632	352	16
Statesman	..	782	..	346	50	978	5	..
Gravenstein	..	229	4	295	..	889	..	12
Ballarat	82	1,252	155	144	15	1,543	..	20
Rome Beauty ..	..	340	30	..	..	454	..	..
Lord Wolseley ..	..	..	..	30	..	5	10	12
Cleopatra	..	..	..	..	..	4	..	..
Washington	..	..	..	40	..	112	..	32
Worcester Pearmain ..	..	..	..	..	..	..	..	..
London Pippin ..	..	1	..	..	..	..	..	..
Tasma	..	..	..	..	..	..	..	..
Scarlet Nonpareil ..	..	..	..	..	..	..	..	..
Newtown Pippin ..	..	..	..	..	..	..	..	..
Other varieties ..	18	817	355	250	..	2,388	270	24
Total ..	1,942	14,467	1,065	3,432	657	20,992	1,449	406

Variety.	Nelson.	Mapua-Tasman.	Motueka.	Marlborough.	Christchurch.	Southern Coastal.	Tuapeka.	Vincent.
Sturmer	1,155	256	1,287	60	378	200	675	20
Delicious	367	216	200	80	239	245	760	607
Jonathan	5	501	..	..	55	6	..	..
Cox's Orange Pippin ..	917	2,175	148	171	632	597	1,201	444
Dunn's	..	396	..	51	..	..	..	20
Dougherty	..	100	112	100	..	..	..	..
Granny Smith ..	538	2,543	2,126	..	83	..	379	171
Statesman	660	1,942	80	..	155	30	424	..
Gravenstein	135	1,262	60	..	20	..	..	..
Ballarat	..	..	..	98	103	400	..	..
Rome Beauty ..	..	..	..	..	2	..	..	..
Lord Wolseley ..	..	..	..	..	349	106	42	20
Cleopatra	..	..	50	..	..	..	904	..
Washington	..	..	5	..	..	..	..	..
Worcester Pearmain ..	..	..	..	..	93	..	..	..
London Pippin ..	..	..	..	..	..	..	..	..
Tasma	75	123	..	76	160	..	330	102
Scarlet Nonpareil ..	..	..	4	..	..	..	..	..
Newtown Pippin ..	..	..	..	..	..	..	370	..
Other varieties ..	3	200	6	192	258	64	420	69
Total ..	3,855	9,714	4,078	828	2,527	1,648	5,505	1,453

A consideration of Table 17 indicates that no definite attempt is being made to concentrate on fewer varieties.

Table 17.—Comparison of Proportions of Varieties for all Trees, and for Plantings under Five Years Old.

Variety.	All Trees.	Plantings under Five Years.	Variety.	All Trees.	Plantings under Five Years.
Sturmer	24·3	12·6	Lord Wolseley ..	1·4	0·8
Delicious ..	20·4	11·1	Cleopatra ..	1·2	1·3
Jonathan.. ..	14·3	2·7	Washington ..	0·7	0·2
Cox's Orange Pippin	7·8	18·3	Worcester Pearmain	0·7	0·1
Dunn's	5·8	2·2	London Pippin ..	0·7	..
Dougherty ..	3·2	1·4	Tasma	0·6	1·2
Granny Smith ..	2·7	22·9	Scarlet Nonpareil ..	0·6	..
Statesman ..	2·7	7·4	Newtown Pippin ..	0·5	0·5
Gravenstein ..	2·4	3·9	Other varieties ..	6·4	7·2
Ballarat	2·2	5·1			
Rome Beauty ..	1·4	1·1	Total ..	100·0	100·0

For the other varieties the proportions of plantings under five years do not vary greatly from those for all trees.

There are three broad factors governing selection of varieties for replacement. They are price, yield, and past popularity. Taking the percentage of Cox's Orange Pippin and Granny Smith of total planting within the last five years, and comparing them with the others to the quotations in Table 15, it is clear that price is having an influence on choice. On the other hand, consideration of the yields of Ballarat and Statesman, as shown in Table 14, indicates how selection is biased by heavy yields, while Sturmer and Delicious demonstrate the effect in varietal planting resulting from past popularity.

A wise selection involves a combination of price and yield, for it is upon the total returns that a choice should rest, after allowing for the advantages and disadvantages introduced by subsidiary factors and market fluctuations.

Conclusion.

This study serves to show that much information can be secured from an extensive survey covering only a few of the salient points. The ready response to the schedules submitted is very satisfactory, and if a similar response is forthcoming for the season of 1931–32 the results presented here can be supplemented and confirmed. By building up a service of this nature a great deal of information can be supplied which, if applied, should result in a measureable improvement not only in the industry as a whole, but also in the annual accounts of individual growers. Co-operation in a work of this nature is essential, as it enables results to be attained that no other method can achieve.

The co-operation of all those who submitted information relative to the production of the season under review is gratefully acknowledged, whether such information was suitable for inclusion in analysis or not.

HOT-WATER TREATMENT OF SEED BARLEY.

CROP RESULTS IN CANTERBURY, SEASONS 1930, 1931, 1932.

C. H. HEWLETT and J. H. HEWLETT, M.A., Canterbury (N.Z.) Seed Co., Ltd., Christchurch.

SINCE the last report on this work,* conducted by the Canterbury Seed Company, with the advice and assistance of Mr. J. C. Neill, Field Mycologist, Department of Agriculture, further results have come to hand which should be of advantage to barley-growers.

For the past five or six years farmers have derived considerable benefit from the use of smut-free pure strains of barley, and the majority of growers took advantage of the opportunities offered. During the past year, however, a number of farmers reverted to the old method of using their own seed. It is a significant fact that one-third of such crops showed distinct traces of covered smut. and the following Tables 1 and 2 show to what a serious extent the quality of such product was thereby adversely affected. The tables refer to the Canterbury barley crop of 1932, and afford a comparison between the quality of the product of treated seed and of growers' own seed.

Table 1.—Grading of Product of Treated Seed.

(In all the tables mill firsts only are dealt with.)

Quality.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer	Total.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
No. 1 Grade ..	53·39	56·97	88·39	64·67	57·76
No. 2 Grade ..	34·54	27·76	11·61	24·66	28·81
Under grade ..	12·07	15·27	..	10·67	13·43
Total	100·0	100·0	100·0	100·0	100·0
Number of farms ..	44	83	5	9	141
Acres	580	1,221	49	183	2,033

Table 2.—Grading of Product of Grower's own Seed.

Quality.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
No. 1 Grade ..	39·7	18·16	34·80	..	23·41
No. 2 Grade ..	30·0	47·89	57·82	..	45·09
Under grade ..	30·3	33·95	7·38	..	31·50
Total	100·0	100·0	100·0	..	100·0
Number of farms ..	6	34	5	..	45
Acres	107	427	40	..	574

NOTE.—Fourteen out of the above forty-five crops of owner's seed showed traces of covered smut.

* See *Journal* for February, 1930, page 104.

The period of the last three years which is reviewed in the following tables is comprised of one good and two bad seasons. The object of these figures is to provide the barley-grower with information which, used in accordance with the knowledge and judgment of his own particular conditions, may be of assistance to him in selecting which variety to sow. The tables present a condensed summary of the actual harvest results.

ELLESMERE DISTRICT.

Table 3.—Yields per Acre.

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	159	3,088	49·04	52·83	25·40	41·15	51·96
1931 ..	221	4,489	34·94	41·32	49·72	69·86	40·33
1932 ..	134	2,003	33·67	38·22	49·28	51·93	38·11
Total ..	514	9,580	37·92	44·76	44·20	51·83	43·61
Number of farms ..		..	99	400	3	12	514
Acres ..		..	1,829	7,461	68	222	9,580

Table 4.—Grading of Product (No. 1 Grade).

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	159	3,088	95·03	79·00	100·00	100·00	81·45
1931 ..	221	4,489	39·42	49·64	100·00	100·00	48·91
1932 ..	134	2,003	45·83	52·71	100·00	83·38	54·78
Total ..	514	9,580	57·18	62·11	100·00	89·50	62·48
Number of farms ..		..	99	400	3	12	514
Acres ..		..	1,829	7,461	68	222	9,580

DUNSANDEL DISTRICT.

Table 5.—Yields per Acre.

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	15	368	51·69	53·50	45·83	..	52·65
1931 ..	22	469	40·26	35·75	28·16	..	35·78
1932 ..	6	116	..	24·28	..	..	24·28
Total ..	43	953	44·39	40·77	38·46	..	40·9
Number of farms ..		..	6	34	3	..	43
Acres ..		..	72	821	60	..	953

Table 6.—Grading of Product (No. 1 Grade).

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	15	368	100·00	80·66	100·00	..	83·61
1931 ..	22	469	87·04	26·57	Nil*	..	32·13
1932 ..	6	116	..	46·02	..	..	46·02
Total ..	43	953	92·49	54·76	69·50	..	58·72
Number of farms ..		..	6	34	3	..	43
Acres		..	72	821	60	..	953

* None passed as No. 1 Grade.

LINCOLN DISTRICT.

Table 7.—Yields per Acre.

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	48	571	53·77	53·08	36·63	34·42	50·60
1931 ..	52	771	52·65	42·03	33·38	51·62	44·97
1932 ..	42	365	46·45	35·56	32·63	..	39·14
Total ..	142	1,707	51·54	44·27	34·14	44·06	45·60
Number of farms ..		..	53	65	20	4	142
Acres		..	564	889	179	75	1,707

Table 8.—Grading of Product (No. 1 Grade).

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	48	571	81·98	71·10	100·00	100·00	78·45
1931 ..	52	771	91·21	61·95	62·19	Nil*	67·99
1932 ..	42	365	70·52	5·00	46·74	..	40·29
Total ..	142	1,707	83·20	56·93	69·83	34·38	66·80
Number of farms ..		..	53	65	20	4	142
Acres		..	564	889	179	75	1,707

* None passed as No. 1 Grade.

NORTH CANTERBURY DISTRICT.

Table 9.—Yields per Acre.

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
1930 ..	5	128	..	41·50	..	57·36	52·41
1931 ..	8	182	..	35·00	..	49·95	45·35
1932 ..	4	123	27·00	15·00	..	48·93	28·82
Total ..	17	433	27·00	29·00	..	52·32	42·74
Number of farms ..		..	1	6	..	10	17
Acres ..		..	20	156	..	257	433

Table 10.—Grading of Product (No. 1 Grade).

Year.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1930 ..	5	128	..	Nil*	..	46·35	34·88
1931 ..	8	182	..	64·29	..	27·14	35·96
1932 ..	4	123	Nil*	Nil*	..	Nil*	Nil*
Total ..	17	433	Nil*	27·88	..	24·06	28·68
Number of farms ..		..	1	6	..	10	17
Acres ..		..	20	156	..	257	433

* None passed as No. 1 Grade.

SUMMARY OF DISTRICTS, 1930, 1931, 1932.

Table 11.—Yields per Acre.

District.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
			Bushels.	Bushels.	Bushels.	Bushels.	Bushels.
Ellesmere ..	514	9,580	37·92	44·76	44·20	51·83	43·62
Dunsandel ..	43	953	44·39	40·77	38·46	..	40·90
Lincoln ..	142	1,707	51·54	44·27	34·14	44·06	45·60
North Canterbury	17	433	27·00	29·00	..	52·32	42·74
Total ..	716	12,673	41·12	44·10	37·21	51·00	43·65
Number of farms ..		..	159	505	26	26	716
Acres ..		..	2,485	9,327	307	554	12,673

Table 12.—Grading of Product (No. 1 Grade).

District.	Number of Farms.	Acres.	Chevallier.	Spratt-Archer.	Goldthorpe-Spratt.	Plumage Archer.	Total.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Ellesmere ..	514	9,580	57·18	62·11	100·00	89·50	62·48
Dunsandel ..	43	953	92·49	54·76	69·50	..	58·72
Lincoln ..	142	1,707	83·20	56·93	69·83	34·38	66·80
North Canterbury	17	433	Nil*	27·88	..	24·06	28·68
Total ..	716	12,673	66·05	60·64	77·70	54·79	61·69
Number of farms ..		..	159	505	26	26	716
Acres ..		..	2,485	9,327	307	554	12,673

* None passed as No. 1 Grade.

From detailed observation of the foregoing crops before and after harvest, combined with the information given in the tables, it seems clear that in order to obtain the best results from Spratt-Archer and Plumage Archer it is necessary that both the varieties should be sown on heavy land only.

Limited space precludes detailed comment on each table, but the tables are so drawn up that the grower may refer to any variety in any particular district. The results show the importance of sowing only smut-free seed of the purest strains on land suitable for its production.

SOAKING OF PASPALUM SEED PRIOR TO SOWING.

TRIALS have been made with various lines of paspalum seed, the results of which indicate that while soaking does not result in any significant increase in the total percentage of germination it certainly does materially increase germination speed. It was found, however, that temperatures over 60° centigrade (140° Fahrenheit) depressed germination, and that temperatures over 70° C. (160° F.) were totally fatal.

An immersion for five minutes at 60° C. gives good results, but an eighteen to twenty-four hours' soak at approximate room temperature is equally successful, and attendant with no risk of damage as is the case when soaking at high temperatures for prolonged periods.

—*N. R. Foy, Seed Analyst, Plant Research Station.*

Top-dressing of Chewings Fescue for Seed.—Officers of the Fields Division report good results from this practice in Southland during the past season. Some fescue paddocks near Gore top-dressed with lime about three months before closing up for seed, and then top-dressed with sulphate of ammonia at 1 cwt. per acre just before closing up, showed a great response in seed yield. At Nightcaps 1 cwt. of sulphate of ammonia per acre on an area of 30 acres of fescue, top-dressing in spring, produced 97 bags of seed. The same area not top-dressed in season 1930–31 produced 45 bags, and in season 1929–30 60 bags. Top-dressing of the pastures with superphosphate was also carried out.

SEASONAL NOTES.

THE FARM.

Pasture Establishment.

UNDER a wide range of conditions pasture-seed mixtures often may be sown suitably in September. To obtain the greatest assurance of maximum success from the sowing of pasture seed several matters require careful attention. Of outstanding importance is the use of suitable strains of the plants being sown. As yet differences between strains of the one species are of most marked practical importance in what is loosely known commercially as "perennial" rye-grass—the term being used in this relation to embrace not only material which is truly perennial, but also material which is definitely short-lived in character.

In those extensive districts with a rainfall, say, of 35 in. or more, which favours the growth of rye-grass, there is no need to demonstrate the value of being able to ensure its permanence in swards of long duration. But the advantage of using truly perennial rye-grass in drier districts seems not to be so clearly understood. Because of this, about two years ago the Department of Agriculture inaugurated trials in Canterbury for the purpose of comparing the carrying-capacity of swards containing different types of rye-grass. A recent interim report on five of these trials, in all of which grazing is carried out by sheep, provides instructive data. During the first period, which covers approximately a year, 130 days of grazing were obtained on the plots containing true perennial rye-grass for every 100 days of grazing obtained on the companion plots containing the non-perennial type. In the second period, which covered a portion of the second autumn in the life of the sward, the factor of permanency of strain began to operate more strongly, with the result that 186 days of grazing were obtained on the plots containing true perennial rye-grass for every 100 days of grazing obtained from the companion plots. These data indicate differences in carrying-capacity of a kind which has been repeated in a manner readily visible on many trials of a similar type throughout the Dominion. Differences of similar practical importance are found to occur between various strains of such important pasture species as white clover and cocksfoot, and almost invariably imported seeds of these species are definitely inferior to seed of New Zealand origin.

The practical application of our current knowledge of strain differences in species of pasture plants is the use in seed mixtures of only true perennial rye-grass, New Zealand cocksfoot, and New Zealand white clover. At times, and especially in respect to perennial rye-grass, the price of the superior strain may seem to be disproportionately high, but when it is kept in mind that the use of inferior strains is likely to lead either to a long period of unnecessarily depressed yield or to unnecessarily early breaking-up and resowing of the sward, then the comparatively high cost of the superior strains of seed will not seem sufficient to justify dispensing with their use. If supplies of true perennial rye-grass are not conveniently obtainable by the purchase of certified seed, then it becomes advisable to resort to lines of seed of which it can be ascertained reliably that they have reacted favourably under the special ultra-violet light test carried out by the Department of Agriculture.

Another factor of importance in the purchase of pasture seed, and incidentally of practically all kinds of seed, is its "real value" ascertained principally by consideration of its germination capacity and purity. It seems such an obviously common-sense proceeding to buy comparatively

expensive seeds only on the basis of their content of live seeds of the sort to be sown that it is really surprising that farmers generally buy their seeds in a blind fashion. Farmers would do well to remember that they seldom can sell their seeds really advantageously in a similar fashion. The two principal points which seem to be generally overlooked by farmers are, firstly, that the appearance of most seeds is a very incomplete indication of their real value; and, secondly, that farmers by taking suitable simple steps may obtain gratis through the activities of the Seed-testing Station all the information they need about seed they contemplate using. In this connection it may be worth noting that certified seed is not at all necessarily of good germination or purity, and so, especially on account of its relatively high price, its purchase should be based at least partly on a knowledge of these qualities—knowledge which should be readily procurable from the vendors of the seed, as this information is officially supplied to the owners of the seed at the time of certification.

Pasture Seed Mixtures.

The following three seed mixtures will suitably cover the requirements of the great majority of farmers:—

(1) For a temporary pasture of one to two years' duration: Italian rye-grass, 25 lb. to 30 lb.; red-clover, 6 lb.—total, 31 lb. to 36 lb., per acre. Temporary pastures that such a mixture would provide are of considerable value as a means of spelling and building up the fertility of land which has been impoverished to some extent by a period of cultivation, and as a means of freeing land of weeds, such as blackberry, prior to the sowing of a permanent pasture. In general, temporary pastures are most effective when sown in the autumn, as they are then likely to be of special value in providing additional feed for winter and spring, but they are also at times quite useful when sown in the spring following a root or other special crop such as swedes, chou moellier, &c.

(2) For what are called short-rotation pastures that are intended to have a life of two or three years: Italian rye-grass, 15 lb.; perennial rye-grass, 15 lb.; red clover, 4 lb.; white clover, 2 lb.—total, 36 lb., per acre. Short-rotation pastures are most generally of value on farms on which, mainly because of climatic conditions, cereals and other arable crops instead of pastures are the principal considerations.

(3) For pastures which are intended to occupy the land as permanently as possible the following mixture is recommended by Mr. E. Bruce Levy, Agrostologist, as suitable for use over wide areas in both North and South Islands: True perennial rye-grass, 20 lb. to 25 lb.; New Zealand cocksfoot, 10 lb. to 15 lb.; crested dogstail, 3 lb.; timothy, 3 lb.; New Zealand white clover, 2 lb.; red clover, 3 lb.—total, 46 lb., per acre. This mixture is recommended for use on country with a carrying-capacity which is, or can economically be increased to, one cow to 2 or 3 acres or better, or two to three ewes to the acre or better. The larger amount of cocksfoot is to be used only when the smaller amount of rye-grass is used, and the latter is advisable either when the summer rainfall is below that needed for good results with rye-grass, as under Canterbury or similar conditions, or when it would not be economical, even though the rainfall is sufficient, to raise the fertility of the land by top-dressing up to good rye-grass standard.

Under certain special conditions modifications of the above seed mixture for permanent pasture may be desirable. The most important of the modifications are: (*a*) Poa trivialis at the rate of 2 lb. per acre should be included on country which is of good quality and which is comparatively damp in winter. (*b*) On fertile swamps which are too wet in the winter for success with rye-grass, and which cannot readily be drained sufficiently, meadow foxtail at 6 lb. per acre should be included; but if it is at all possible to drain the land enough to make it suitable for rye-grass this

should be done in preference to sowing the meadow foxtail. (*c*) In many relatively mild northern districts of the North Island paspalum at 6 lb. to 8 lb. per acre may at times advantageously replace cocksfoot.

As a rule permanent pastures are most successfully established when sown without companion crops, which somewhat misleadingly at times are called "nurse" crops. If these are good vigorous crops they are likely to weaken the young pastures by overshading, rather than to assist them.

Provision of Special Feed.

One of the most important objectives of spring field-work should be the eventual provision of ample reserves of feed for use during those times when the feed directly available from pastures is less than the requirements of stock. For use in the winter period, mangels, carrots, chou moellier, swedes, and turnips are all suitable. Except in the more severe and southern districts, mangels give excellent returns when accorded good fertility and good cultivation. They are extremely reliable, being practically free from attacks of any serious disease; they can withstand dry periods relatively well, and under suitable treatment their total yield of nutriment per acre is very high. Because of these facts they should be grown much more extensively than in the past.

Swedes and turnips may often fittingly replace mangels when the farming is of a more extensive type so that the good treatment desirable for mangels cannot really be accorded a crop. Carrots are suited to free fertile soils on which, as Taranaki results demonstrate, really good yields can be obtained. Chou moellier rightly has won considerable popularity in recent vears for use on good ground, especially on ground that is inclined to be so wet at the time of feeding-off as to make the use of swedes not altogether suitable. Chou moellier is also very suitable when club-root infection is known or expected to be present in the land to be cropped—the plant, though not completely immune, being very resistant to attacks of this serious disease. For use in summer rape and soft turnips rightly have a wide vogue, and in the warmer districts green maize and millet, provided they are utilized when in a young leafy stage, are fitted to give good results.

Cultivation for all these crops should be proceeded with as early as possible. Cultivation subsequent to ploughing is usually very valuable not only in mellowing the soil, but also in destroying crops of weed seedlings which at times develop in great numbers.

The establishment of a stand of lucerne is a most important matter to which greater attention could well be given at this season. Much information about lucerne culture is provided in the Agriculture Department's Bulletin 155, obtainable on application.

Fields for Ensilage and Hay.

Haymaking and especially ensilage are important means of obtaining reserves of feed for which preparation may be commenced at this season. Fields intended for either practice should be thoroughly cleaned off and closed up as soon as they can be spared from grazing. All material such as wire, timber, &c., likely to cause delays or breakages in mowing should be carefully removed. Early closing up of such fields is valuable in that it favours the possibility of early mowing, which in its turn gives greater probability of a good aftermath that is generally markedly useful when the dry summer weather makes its effect felt. A top-dressing with superphosphate at closing-up time of fields intended for ensilage or haymaking is often advisable, especially in the case of fields not recently top-dressed.

September is often also a suitable time to close up lucerne areas. It assists greatly in obtaining a comparatively early cut which is suitably saved as silage, followed by a second cut at about New Year which is

valuable either for hay or green feed. The general result of early closing of lucerne and the conservation of the first cut as silage is an extra cut from the lucerne annually.

General Cropping Work.

Last month's notes relative to cropping generally are applicable broadly to the work requiring attention in September. Tine harrowing of land occupied by cereals sown in autumn or winter may be advisable for the purpose of loosening the surface of land which has become caked. Grass or cereal crops cannot safely follow a previous grass or cereal crop which was attacked by the grass-grub.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Spring Spraying.

WHERE spring sprayings of bordeaux mixture have not been applied in accordance with the directions given in last month's *Journal* no time should be lost in making the application.

Apples and pears: Among the more prominent ailments of apples and pears which require control by spraying between now and the blossoming period are black-spot and powdery mildew, and red mite and scale. For the fungus diseases foundation sprays of bordeaux 5–4–50 or lime-sulphur 1 per cent. should be applied at bud-movement, and again at the pre-pink stage, but reducing the strength of the lime-sulphur to 0·2 per cent. Should powdery mildew be very troublesome lime-sulphur is the best remedy, and it is very necessary to close up the gap between the last pre-blossom spray and the calyx application. During this period the leaves are emerging very rapidly and require a protective covering. To reduce this gap apply a 0·2 per cent. lime-sulphur spray as late as possible before blossoming and bring forward the calyx spray, not waiting for the whole of the petals to fall. Included in the calyx spray will be lime-sulphur 0·1 per cent. and 2 to 3 lb. of a colloidal sulphur. For the satisfactory control of mildew the trees must be made as vigorous as possible by efficient cultivation, manuring, and irrigation.

The strengths of lime-sulphur given above are in terms of the polysulphide content of the particular lime-sulphur which the grower may be using, and for which a table of dilution was given by Dr. G. H. Cunningham on page 265 of the April issue of the *Journal*. As this method of calculating the amounts of dilution for the different lime-sulphurs is a complete change from former practice, the following examples may be of considerable assistance to growers. The strengths suggested for the different periods of growth are: Dormancy to bud-movement, 1 per cent. polysulphide content; green-tip to pre-pink, 0·2 per cent.; summer, 0·1 per cent.; for autumn use on apple varieties susceptible to spray injury, and for stone fruits, 0·083 per cent.

Taking two examples of lime-sulphurs, one with a polysulphide content of, say, 19 per cent. and the other of 12 per cent., the necessary strengths for application to the trees at the different stages of growth would be as follows:—

Polysulphide Content Percentages.	1 per Cent. Dormancy to Bud-movement.	0·2 per Cent. Green-tip to Pre-pink.	0·1 per Cent. Summer.	0·083 per Cent. Autumn Applications on Susceptible Apple Varieties and for Stone Fruit.
19	1 in 19	1 in 95	1 in 190	1 in 228
12	1 in 12	1 in 60	1 in 120	1 in 144

For the control of red mite and scale insects some growers still prefer to apply a dormant or semi-dormant red-oil emulsion at a strength of 1 in 10 to 1 in 20; others are relying on the summer oils, which have really given the best control.

Cultivation and Irrigation.

Those who have not yet turned under their green crop should do so without delay. The soil should now be disked into a fine tilth as soon as it is fit to work. The disks, cultivators, and harrows must be freely used to keep the soil firm yet open so as to retain the moisture as long as possible. In those districts where irrigation is a general practice, watering should start much earlier than is generally the case. Water is abundant in the early part of the season, and should be availed of to put the necessary reserve of water into the soil. The result would be a better start for the trees in the spring, the greater certainty of any manures that have been applied being rendered available for the tree's use, the greater ease of applying later waterings, and the lesser quantity required to keep the soil moist. Delaying as late in the spring as possible before commencing to irrigate is bad practice. After the exceptionally dry autumn and winter experienced in Central Otago, irrigation should be commenced there as early as possible.

The Orchardist's Nursery.

No delay should occur in the planting of stocks which have been procured from elsewhere; they should now be in the nursery rows. The soil round these and any cuttings that have been set out should be kept in good tilth and free from weeds. Every effort should be made to keep the trees growing vigorously, so that they may be in a condition to bud next autumn. As explained in last month's notes, plum, apricot, and peach stones should have been sown, the latter for transplanting into nursery rows as soon as they are through the ground and large enough to handle. Any misses of apples and pears budded last autumn should be grafted with scions which have been kept dormant, when the stock has definitely commenced growth and the sap is running freely.

Through an oversight, the raising of apple-stocks was omitted from last month's notes; however, in most districts it may not be too late if they are attended to immediately. The present system in New Zealand is to work apples on to a "blight-proof" stock—that is, on apple roots that are resistant to the attack of woolly aphis. Northern Spy is the stock which has been used for many years in this country. To raise these stocks roots are taken from trees that are known to be on the desired stock. The best size of root is about the thickness of an ordinary lead pencil. Cut these roots into lengths of about 3 in., keeping them moist by placing them immediately into a box and covering them with damp moss or grass. In this way they will hold without drying out for some days. Procure scions of Northern Spy wood, which should not be thicker than the roots on which they are to be grafted. Cut the scions into 3 in. or 4 in. lengths—four buds. The whip or tongue graft is used for this grafting, and in doing so allow for the bottom bud of the scion to be near the bottom, so that when the scion is fitted to the stock this lower bud will be opposite the lower end of the union. Every effort must be made to obtain a good fit between scion and root. They are then firmly bound together with raffia, no wax being required. At times this grafting is done in the winter, and in such cases the grafted roots are bedded into soil until the ground is ready. If they are to be planted out within a few days, they can be placed in a box and covered with moist moss or grass or damp sand as mentioned above. In neither instance must the stock or scion (either before or after grafting) be allowed to dry. The soil where the grafted roots are to be planted must be well worked down and in good condition before planting. They are planted out in

nursery rows somewhat as advised for cuttings, but as the root grafts are less than half the length of the cuttings, the firm bottom on which they rest will be shallower. They are planted in rows 1 ft. 6 in. apart and 3 in. to 4 in. between the plants, as they will be lifted and replanted next season. They should be planted with about 1 in. of scion showing above the ground, which is trodden firmly as with the cuttings.

Miscellaneous.

Planting and pruning should now have been completed, and all prunings, rubbish, &c., burned. If through any cause trees for planting have arrived late, give them a good watering after planting before placing the final loose soil on top.

Potash and phosphate manures should also have been sown, but should this not have been done they may still be applied. Sulphate of ammonia or nitrate of soda may be applied shortly, for preference the former should be sown at green-tip and the latter at pink.

Watchful care must be kept for fireblight. Wherever it is noted cut back limb or shoot well below the infected area, all tools used being efficiently disinfected.

— *W. R. L. Williams, Orchard Instructor, Alexandra.*

Citrus Culture.

Owing to the showery and spring-like conditions obtaining during the autumn, a fair amount of young growth was produced in many citrus orchards which had no time to harden before the winter set in. It is possible that some of this growth will have been damaged by frost, and it will not be wise to cut such parts back until all danger of frost is over. The work should not, however, be unduly delayed, as dead and dying wood is always more or less injurious to any growing trees.

A careful watch should be kept for any indication of borer and all cavities should be treated with an injection of benzine, afterwards blocking the hole with soap or some other plastic material. If small branches only are infested it may be more advisable to cut them out and burn.

During the coming month, if weather and other conditions are suitable, it may be necessary to consider cultivation. Ploughing is essential in order to turn under green crops, if they have been grown, or weeds that may have been produced. Do not plough deeply, as this will only cause undue injury to the roots. Ploughing in good time gives the land a chance to dry and become in a more suitable condition for development of the roots, this being reflected in the growth and vigour of the trees.

A sharp look-out should be kept for the appearance of scale insects, and the fact noted in order that they may be dealt with when the weather becomes warmer. Spraying for their control is better delayed until well on in the spring.

Continue gathering lemons as they reach the required size. By doing this the trees have a much better chance of producing a uniform fruit. Do not try to market any fruit that has been damaged by the frost, as this will only tend to cause buyers to dislike the New-Zealand-grown article. When lemons have been affected by frost they lose their juice content, and when cut have a very dry appearance.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

The Hatching of Ducklings.

THERE is yet ample time to hatch out ducklings for the renewal of the laying flock, but September should see all eggs undergoing the process of incubation for the production of ducklings for the Christmas market. To

cater for this market the eggs should be put down about fifteen weeks before the young birds are to be marketed. This will allow twenty-eight days for hatching (the natural time), and the remainder for rearing the birds to prime condition.

A point may be mentioned here in regard to mating ducks. They should be mated well in advance of the time when the eggs are required for hatching purposes, or a large proportion of infertile eggs may be expected. Ducks, especially the heavier breeds, have usually to be mated much longer than fowls in order to ensure a maximum number of fertile eggs. In mating Indian Runners one drake to six ducks, and for the heavier breeds one drake to four ducks, are the proportions for breeding purposes at this period of the year, but during the summer or natural laying season the number of ducks may be considerably increased. The amount of range provided and also the vigour and health of the males must be considered in mating operations. When the drakes commence fighting it is usually an indication that more ducks are required in the breeding-pen, or that the number of drakes should be lessened. Good fertility can be obtained from Indian Runners when they are kept away from water, but for the heavier breeds better results are obtained if water is provided.

Where incubators are used for hatching purposes, the temperature to be maintained is 102° F. for the first week and 103° for the remainder of the incubation period. It is a good plan to spray the eggs with water at a temperature of 103° every morning after the fourteenth day. The water may be applied by means of the mouth or a fine florist's spray. Immediately the eggs are taken out of the machine they should be quickly turned, sprayed, and replaced in the incubator. Never cool after spraying, but spray in the morning and cool at night. The incubator vents should at all times be partly open, so that any excessive moisture, not absorbed by the eggs can escape. Generally speaking, no further moisture is required. The spraying of the eggs not only has the effect of bringing the air-cell down to a desired line, but also softens and weakens the membrane lining of the shell, which assists the young duckling to emerge. The period of incubation for duck eggs is twenty-eight days, but the ducklings commence to pip on the twenty-sixth day, and therefore the novice must be careful not to try and help the young birds out of the shell until they have been given their full time to hatch out.

Do not feed the young birds for the first twenty-four to thirty-six hours after hatching. For the first few days give equal parts of bran and pollard, mixed with a small quantity of oatmeal and 5 per cent. of finely broken sea-shell and gravel grit (not sand), the whole to be moistened to a desired consistency with skim-milk or hot water. After the first week, finely cut green material, such as silver-beet, lettuce, succulent grass, oats, watercress, &c., must be fed daily. When the ducklings are about ten days old 5 per cent. of minced boiled meat may be added to the mash mixture, and this proportion should be increased up to 10 per cent. as the ducklings develop. After the first week the oatmeal may be dispensed with, and white ground wheat, barley, or oats with the husks screened out may be included in the mash. Feed four times a day, as much as the birds will pick up clean. Ducklings should be fed from troughs, otherwise much of the food will be wasted. After the young birds are a week old do not mix the grit with the food, but keep it within easy reach so that they can help themselves.

The drinking-vessels should be sufficiently deep to allow the ducklings to clean out their nostrils and so prevent the latter from becoming clogged up with food, &c., as this is a common cause of the eyes becoming plastered and of the weakening of the legs and back, as well as other troubles. Some fine gravel placed in the drinking vessel will greatly assist in moving any food or dirt from the nostrils. During the brooder stage, ducklings should have drinking water available to them night and day. If after a long fast

water is supplied, and especially before the birds have been given a meal, fatal results are almost sure to follow. The affected ducklings will be observed to stagger, fall on their backs, and appear to be in a fit, when death soon follows. Where it is found that the drinking vessels are empty, and the birds have been without water for some time, it is a good plan to take the chill off the water before giving it to the birds to drink.

Never allow ducklings to sleep on damp or wet bedding, as this is a common cause of leg weakness, and once a duckling becomes affected in this way little or nothing can be done for it. It is really a matter of prevention by checking everything that tends to create a moist atmosphere. The first essential to this end is to place the water-vessels well away from the sleeping-quarters, so as to prevent the bedding-materials from getting wet.

Young ducklings should be always protected from hot sun, as they have thin skulls and are very prone to sunstroke, which is a common cause of heavy mortality. Good shade is the secret for preventing this trouble.

In rearing ducklings, no matter what class of brooder is being used, care must be taken to provide the young birds with an ample supply of fresh air. Without this the mortality is sure to be great. Good ventilation should go hand in hand with a uniform degree of warmth—say, a temperature of 90° at the start and reducing this gradually as the ducklings develop.

Provision of Green Feed.

Every effort should be made to grow an abundant supply of green material for future use. Green feed serves a threefold purpose, for it not only keeps the fowls in good health and gives the yolk of eggs the desired rich colour, but it materially assists in reducing the grain bill and thereby makes for economical production. It cannot be too strongly emphasized that for young stock to make the best growth they must never receive a set-back, and one of the worst checks to healthy development is lack of green stuff during the growing stage. Silver-beet is an excellent thing to grow for poultry, and is a heavy cropper. Any of the cabbage family, including rape, or alternatively mangels, carrots, and green oats, may be grown to advantage. In these days of high cost of grain materials, it will pay well to feed green material with a free hand, particularly where growing stock are concerned.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Uniting Weak Colonies.

NORMALLY, at this season of the year there are usually large patches of brood in the hives. A further examination may be carried out where the beekeeper was in doubt on the previous occasion as to the hive being queenless or not. The absence of brood at this season will denote a poor queen or that the hive is queenless. In either case it is advisable to unite with another hive. This should be done immediately, as a queenless hive stands in great danger of being robbed by other bees in the apiary. A ready method of uniting is by placing the weak colony over a strong one on the stand of the latter, with a sheet of newspaper between the two hive-bodies. They may be examined after a couple of days to see if things are going well, and if the paper is not bitten through it should be torn in several places. In another day or two the united colonies will be working peaceably. In the case of the weaker colony it is wise to kill the queen before uniting.

At this examination the beekeeper must keep a strict watch for symptoms of disease. If foul-brood is discovered in a mild form the colony should be marked for treatment later in the season. Should, however, the colony be badly affected it is advisable to sulphur the bees and destroy the combs. Care should be taken to remove the hive to a place of safety until it can be properly cleansed.

Overhauling the Hives.

In August a great deal of the preliminary seasonal work of the apiary may be done. Each hive should receive a good coat of paint. This will help to preserve the timber, besides giving the hives a neat appearance. The bottom-boards should be scraped clean. During the winter months there is usually an accumulation of cappings, pollen, and dead bees, and if left this becomes a harbour for woodlice, which are very objectionable. A simple plan is to provide a spare bottom-board. Lift the hive on to the spare one, scrape the old board, and replace the hive. Remove all top boxes, as advised last month, and make the bees snug and warm for brood-rearing. Remove all weeds and long grass from round the hive. Long grass keeps the hives and bottom-boards damp, and acts as a harbour for insects.

Cleansing Hives and Frames.

The beekeeper should not fail to cleanse all hives and frames that have been in contact with diseased colonies. This work may be undertaken now, and the hives and frames prepared for future use. Where there is only a small number of frames to be cleansed it is hardly worth while to attempt to save them. However, if much material has to be treated the saving effected will more than pay the beekeeper for his time and labour. There are several methods for treating hives and material, but perhaps the simplest and most effective is the use of boiling water and caustic soda. Many beekeepers recommend the use of a painter's blow-lamp, but this tool is not always handy, and, besides, the charring of the hives is an advertisement for all time that they once contained diseased bees.

The most suitable vessel for cleaning frames is an ordinary washing-boiler. To every 8 gallons of water add 1 lb. of caustic soda, and allow to boil. The frames may be tied in bundles of six and immersed in the liquid. The caustic soda attacks the propolis and wax, and this immediately floats on top of the water. Three to five minutes' immersion will serve to cleanse each bundle of frames. Skim the refuse from the top of the water frequently, and as the solution weakens add more soda. Stack the frames in supers and place in the sun to dry. The hive-bodies and bottom-boards may be cleansed by means of a swab. Immerse the swab in the boiling water, and carefully wash the inside of the hives. Care must be taken when using caustic soda, as it is liable to burn the hands.

Prevention of Robbing.

A strict watch should be kept for robbing. This is most likely to occur when feeding has to be undertaken, and once started it is about the hardest matter to cure. Feed only in the evening, if possible, so that the excitement created by the supply of warm syrup will have died down before morning. Keep the entrances to all hives contracted, and see that there are no cracks through which a robber could possibly enter. Perhaps the main cause of robbing, however, is the presence in the apiary of queenless or weak colonies. If the bees once discover a queenless hive there will be no peace until the source of trouble is removed. The inmates of such a hive will not defend their stores as bees in a normal condition will, and unless the colony is united with another it will tend to demoralize the rest of the apiary, until none but strong colonies will be safe from the depredations of the robbers.

Where a weak colony is in danger of being attacked, and where the beekeeper is satisfied that it is worth saving—that is, if he considers the queen good enough to build up a strong colony by the time the main honey-flow sets in—his best plan is to pile wet grass on the alighting-board and well up above the entrance, keeping the grass wet for a day or two, and painting any cracks in the hive with kerosene or carbolic solution. This treatment will soon settle the robbers and restore peace in the bee-yard. However, the best thing to do with weak colonies is to unite them without delay with stronger hives. Like most other troubles, though, prevention is the best thing when dealing with robbers. Do not spill any syrup near the hive, do not leave any combs lying about, and do not have any weak colonies, and you will not be troubled with robbing.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Small Fruits.

LIGHT cultivation in fine weather to suppress weeds, and the application of chemical sprays as may be necessary to keep the plants free from the attack of fungus and insect parasites, is the chief work in this section at present. Where new plantations of bush fruits have been made a little judicious intercropping may be done, so as to enable some return from the land to be obtained this season, so long as the welfare of the permanent crop is not interfered with.

Towards the end of September is the season for planting out or sowing passion-fruit. In the light of experience on larger acreages some modifications in the construction of the trellis and spacing the plants have been suggested, as follows: The posts of the trellis should be 5 ft. out of the ground and 2 ft. in; they should not be more than 27 ft. apart, with the end posts well strutted. The top wire should be double, one on either side of the post, and another wire 3 ft. below—that is, 2 ft. from the ground. There should be 9 ft. between the rows of plants and the plants set 10 ft. apart beneath the trellis, requiring about 480 plants to the acre. Where each plant is to be set a light stake should be inserted and tied for security to one of the wires above. The plants should be set firmly in position, one at the foot of each stake to which it should be tied as growth is made. Any lateral growth developing should have the top nipped off after three or four leaves have been formed. Under this treatment a single vine is run up quickly to the double top wires, where it should be stopped and four leaders encouraged to develop, two being trained in on the top wires, both to the right and left of the stake. In this way the permanent framework of the vines is developed, and laterals from it, formed annually, bear the fruit, after which the bearing laterals should be cut back to just beyond the second bud from the base.

The Tomato Crops.

Successful cropping under glass depends chiefly on good management at the present time. This has to do mainly with close attention to the important requirements of air and water. Extreme temperatures, either way, should be avoided. When water is necessary it should be tepid and applied during the morning. If a thorough soaking was given before planting little will be required, generally, for some time. The same remarks apply to boxes of seedlings, in the frames, which are being raised for planting outside. When the plants which are to fruit under glass form their first truss of blossom, the setting of the fruit will be assisted materially if the

plants are shaken to distribute the pollen. This is usually done about midday, in fine weather, by jarring the strings to which they are attached.

Late frosts have caused damage in some districts, during recent years, to crops under glass. In the absence of a hot-water heating-system the best policy is to keep the plants sturdy by avoiding excessively high temperatures, and have them in dry condition at night by watering in the morning. In extreme cases some kind of emergency heating may be required, but it must be such as will not liberate dangerous gases liable to cause more damage than the frost. If a crop under glass should be struck by frost the damage may be lessened by spraying with whitewash the outside of the house before the sun strikes it. By thus shading the crop and regulating ventilation to avoid a sudden rise in temperature, a quick thaw, which is so damaging, will be avoided.

Land for the outside crop should be prepared in dry weather so soon as it is available. In doing this if ¼ lb. of bonedust per square yard is ploughed under it will generally be beneficial.

Vegetable Crops.

At this period the end of the harvest of winter cabbage and broccoli is approaching, and that of spring cabbage and cauliflower is about to commence. The quality of winter root crops will be falling away, except that of autumn-sown shorthorn carrots, which are often dug now in very nice condition. Good spinnach, celery, and leeks will often be available, but with the return of warm weather they will commence to bolt. Most important is the asparagus crop, the harvesting of which will now commence; with rhubarb it supplements rather well the comparatively lean resources of the garden at this season.

Young plants set out should be weeded by hoeing in fine weather. It is less costly if this is done before the weeds form their second leaves. Seedling crops will require the same attention as soon as they germinate and the rows can be distinguished. Until the plants meet overhead this weeding must not be neglected if a good crop is to be obtained.

Main crop potatoes, cabbage, and cauliflowers should now be planted. The sowings for the month will consist chiefly of main crop carrots, beetroot, peas; salads, turnips, and parsley; and, towards the end of the month, leeks and celery. Where birds or mice may be troublesome peas should be given a dressing of kerosene and red-lead before sowing them.

Land should be prepared for the half-hardy crops of dwarf and runner beans, marrows, pumpkins, cucumbers, and melons to be sown next month. An early crop of small marrows is always very much appreciated, and in warm localities where they may be grown they should be started as soon as possible; in some instances the plants may be raised in boxes and planted out with advantage.

The Homestead Garden.

The planting of trees and shrubs should now be completed as soon as possible, as the planting season for hard-wooded plants is now drawing to a close. The pruning of evergreen shrubs may now be done; chiefly this will consist of thinning out the growth where it is crowded, and the removal of dead wood.

Lawns will require considerable attention now for a while. They should be cut when the grass is dry, and the verges trued up where they have spread. Two or three small applications of sulphate of ammonia at intervals of about three weeks will suppress weeds and clover and improve the grasses; it is best mixed with sand before applying it. Most lawns would benefit, on light land especially, from more frequent rolling now; for this operation the grass should be dry. Where the land is heavy and wet there is danger, if too heavy a roller is used, of consolidating the soil

to the extent of interfering with drainage, and the turf will suffer from lack of air ; this extreme should be avoided. New lawns should be cut with a mower with the knife raised so as to avoid the mistake of cutting too close. This should be followed up with the frequent use of a roller that at first does not exceed 2 cwt. This weight should be increased after several cuttings have been made, especially if the land is light. Good lawns and clean walks are the most important features in a well-designed garden, and they are in most places easily obtained with seasonable attention. A good week-killer applied to walks and drives now will keep them free from weeds for the rest of the season.

House plants requiring repotting or top-dressing should be given that attention now. Rooms, halls, and verandas in this country usually provide conditions for many handsome plants to grow to perfection. Begonia rex, asparagus, aspidistra, palms, ferns, cyclamen, cinerarias, and hydrangea grow best in rather shaded positions. Cacti and pelargoniums, zonal and regal, grow best where the conditions are dry and sunny. All house-plants require fresh air, but cold draughts quickly cause serious injury.

—*W. C. Hyde, Horticulturist, Wellington.*

SOME DAIRY-FACTORY DATA, 1931-32.

In the year ended 31st March, 1932, 99,548 tons of creamery butter and 83,299 tons of cheese were graded for export, the produce being manufactured by 370 companies operating 468 factories. Of these companies, 126 were engaged in buttermaking, 186 in the manufacture of cheese, and the remaining 58 made both butter and cheese.

There were 184 companies operating 207 factories making butter, of which 160 of the companies with 181 factories were co-operative, and the quantity of butter graded on their account was 90,959 tons, or 91·372 per cent. of the total. The remaining 24 companies were proprietary, operating 26 factories, and the quantity of their butter graded was 8,589 tons, equal to 8·628 per cent. of the whole. The average butter production per factory was 481 tons.

The cheese was manufactured by 244 companies operating 320 cheese and dual-plant factories. Of these companies, 233 were co-operative, operating 309 factories, and the quantity of their cheese graded was 81,756 tons, or 98·148 per cent. of the total. The remaining 1,543 tons, equal to 1·852 per cent. of the cheese graded, was made by 11 proprietaries operating 11 factories. The average production for all cheese factories was 260 tons.

Converting the amount of butter and cheese made to terms of butterfat, it is found that 82,957 tons of butterfat was represented in the butter, and 32,038 tons in the cheese, a total of 114,995 tons. Of this 107,244 tons, or 93·260 per cent., was manufactured by co-operative companies, and 7,751 tons, or 6·740 per cent., by proprietaries.

The total number of milk or cream suppliers to dairy factories for the year under review was 63,946, of which 54,675 supplied co-operative companies, and 9,271 proprietaries, equal to 85·502 and 14·498 per cent. respectively.

Included in the above were 84 companies operating 85 registered whey-butter factories, which made a total of 1,422 tons of whey butter (as a by-product of cheese manufacture) during the year.

—*Dairy Division.*

CERTIFICATION OF SEED POTATOES.

CROPS PASSED TUBER INSPECTION DURING JULY, 1932.

Aucklander Short-top (N.Z. Sutton's Supreme).

Rich, A. J., R.M.D., Kaiapoi.
Redmond, C., R.M.D., Kimberley.
Dyer, H., Southbrook, Rangiora.
Petrie, J., jun., Swannanoa (Line B.)
Smith, E. A., R.M.D., Lincoln.
Cross, S., R.M.D., Weedon's.
McMullan, J. D., North Road, Kaiapoi.
Barnett, R., Dunsandel.
Mulcock, W. J., Ryan's Road, Christchurch.

Aucklander Tall-top.

Bailey, J., R.M.D., Kaiapoi.
Cross, H. E., Sandy Knolls. (Line A.)
N.Z. Loan and Mercantile Agency Co., Ltd., Christchurch.
Steele, J., R.M.D., Darfield.
Doak, A., Rangiora.
Crowe, E., Waimate.
Hills, W., Oxford Road, Rangiora.
Steele, D., R.M.D., Ohoka.
Watkins, E. R., Springbank, Rangiora.

Dakota.

Eder, W., R.M.D., Sefton.
Adams, D., Highbank, Methven.
Hinton Bros., Templeton.

Up to Date.

Manson, D. J., Enfield, Oamaru.
Gray, J. L., St. Andrew's.

Arran Chief.

Frazer Bros., Southbrook, Rangiora.
Watkins, E. R., Springbank, Rangiora.

King Edward.

Teschner, C. A., Chatton Road, Gore.

Epicure.

Barnett, R., Dunsandel.

Iron Duke.

Robinson, R. G., Box 4, Papanui.

Field Marshal.

Wright, L. T., Annat.

Northern Star.

Robinson, R. G., Box 4, Papanui.

NOTE.—Reference should be made to the full list of provisional certificates published in the June *Journal*, also to a list of crops passed tuber inspection in the July issue.

—*Fields Division.*

FERTILIZER IMPORTATIONS: JUNE QUARTER.

FOLLOWING are particulars of importations of fertilizers into New Zealand for the quarter ended 30th June, 1932:—

Cyanimide, nitrolim, and calcium cyanamide: Norway, 5 tons. *Nitrate of soda:* Chile, 540 tons. *Basic slag:* United Kingdom, 2,094 tons; Belgium, 22,420 tons; France, 50 tons. *Guano:* United Kingdom, 10 tons. *Rock phosphate:* Ocean Island, 8,510 tons; Nauru Island, 27,287 tons; Tuamotu Archipelago, 7,077 tons. *Other phosphates:* Belgium, 650 tons. *Kainit:* Germany, 33 tons; Poland, 75 tons. *Muriate of potash:* France, 25 tons; Germany, 43 tons. *Sulphate of potash:* Belgium, 5 tons; France, 5 tons; Germany, 98 tons. *Sulphate of ammonia:* United Kingdom, 1,325 tons. *Other fertilizers:* United Kingdom, 10 cwt.; Malaya, 100 cwt.; Netherlands, 18 cwt.

—*Chemistry Section.*

Correction.—Commercial Fertilizers and their Basis of Sale: In the heading of Table 1, on page 19 of last month's *Journal*, giving the world production and consumption of pure nitrogen, the year should read *1930*, not 1931 as printed.

Granny Mac Apple.—The Orchard Instructor at Hastings reports: "About four years ago an orchardist in Hawke's Bay imported an apple-tree of the Granny Mac variety from Australia, and has since worked over a few more trees. A cross between Granny Smith and McIntosh Red, it was reputed to be highly coloured, but so far it has been very disappointing in this respect, most of the fruit being green, although a few specimens have had an attractive blush. The flesh is white and texture coarse. Maturing about the same time as Delicious, it does not appear to be as good a keeper. Although probably a good bearer, it has nothing outstanding to recommend it."

WEATHER RECORDS: JULY, 1932.

Dominion Meteorological Office.

THE month was a very dry one, possibly the driest July on record. Temperatures were much below average, especially in the North Island, but this was offset by an abundance of sunshine accompanied by an unusual absence of wind. Snow was rather frequent during the month on the high levels, but there were no very heavy falls in the interior.

Rainfall.—The only places where more than the average rain for July was recorded were in Southland, on the shores of Foveaux Strait, Invercargill, for instance, had an excess of 6 per cent. Everywhere else the rainfall was below normal. The departures from the average were fairly small on the east coast of the North Island, but in most other districts there were large deficits. In many cases the total was the lowest hitherto recorded. The interior and the northern and western portions of the South Island were particularly dry. Nelson, for example, had rain on only three days, and the total was only 10 per cent. of the normal. Still more remarkable was the Waiho Gorge total of 0·15 in., falling on only one day, compared with a July average of about 15 in.

Temperature.—Temperatures were practically everywhere below normal. The North Island fared relatively the worse, being on the average about 3° F. colder than usual. In the South Island the farther south one goes the nearer becomes the approach to normal. Ground frosts were very numerous and often severe, but as regards shade temperatures, there were no outstanding extremes.

Sunshine.—The records of sunshine were everywhere above the July average. Nelson had the remarkable total of 194·3 hours, Blenheim ran it close with 186·3 hours, and Hokitika had no less than 160·4 hours.

Pressure Systems.—At this time of year, the meteorologist expects well-developed storm systems moving with regularity from the westward and bringing widespread rains with them. It is usually the most satisfactory period for the forecaster. This year the reverse has been the case. The normal westerly depression associated with the prevailing north-westerly winds of this region has been conspicuous by its absence. North-westerlies predominated in New Zealand on only two days in July. The first of these was the 6th, when they were strong in Cook and Foveaux Straits, and the second on the 31st, when, though general, they were only moderate. In each case a slight westerly depression was passing to the south of New Zealand. The ruling depression was of the cyclonic type and the centres all took a northerly course, the tracks crossing the northern portion of the North Island or passing farther north still.

On the 9th a deep and extensive cyclone covered the Tasman Sea. When, however, the storm was due to pass New Zealand it filled up with extraordinary rapidity and by the night of the 11th it had passed without causing nearly such general rains or such stormy weather over the Dominion as might have been anticipated. There were, however, heavy rainfalls in the northern part of the North Island.

In the succeeding days a number of cyclones followed in the track of the one just mentioned. The majority were shallow, but one whose centre passed near Auckland on the 14th was fairly deep and strong southerly winds blew in its rear. Again, there were some heavy rains in the North, but much of the remainder of the country escaped altogether.

The only other vigorous depression was one which after passing to the north of Norfolk Island deepened and moved in an east-south-easterly direction during the 20th and 21st. This was followed by widespread snow.

From the 9th to the 28th inclusive the prevailing winds were from a southerly direction. Though not as a rule strong over the Dominion, to the eastward their speed increased, and the period was a very stormy one over ocean waters in that direction. A factor which contributed to this state of affairs was the persistence of low pressure in the Chatham Islands region from the 11th to the 27th. The low temperatures experienced were a natural consequence of the southerly winds. They were responsible also for changeable erratic weather. Showery conditions with frequent hail or snow on the high levels were the rule at places exposed directly to these winds. Such conditions were persistent on the coast south from Dunedin and on Banks Peninsula.

RAINFALL FOR JULY, 1932, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	3·30	14	1·21	5·63
Russell	4·85	14	1·64	5·30
Whangarei	5·21	17	1·51	7·28
Auckland	4·62	12	1·54	5·07
Hamilton	2·95	12	0·82	5·17
Rotorua	2·17	6	0·93	5·05
Kawhia	1·73	7	0·41	6·17
New Plymouth	2·33	14	0·52	6·46
Riversdale, Inglewood	2·79	11	0·98	10·21
Whangamomona	1·63	4	0·72	7·48
Eltham	2·63	8	1·04	6·06
Tairua	6·12	8	2·14	6·32
Tauranga	4·96	8	2·48	5·23
Maraehako Station, Opotiki ..	2·08	5	0·77	4·58
Gisborne	4·19	15	0·94	5·07
Taupo	2·78	7	1·13	3·91
Napier	3·53	15	1·11	3·82
Hastings	2·95	14	0·79	3·69
Taihape	1·31	13	0·26	3·04
Masterton	2·47	16	0·61	4·24
Patea	1·49	11	0·71	4·33
Wanganui	0·84	5	0·48	3·40
Foxton	0·72	4	0·60	3·24
Wellington	1·48	14	0·67	4·71
South Island.				
Westport	1·94	12	0·64	8·30
Greymouth	2·54	8	1·11	8·03
Hokitika	1·79	8	0·67	8·87
Ross	2·87	6	1·20	9·46
Arthur's Pass	3·41	5	1·60	10·33
Okuru	4·41	6	1·27	10·77
Collingwood	1·69	6	0·75	9·88
Nelson	0·35	3	0·23	3·52
Spring Creek	0·47	5	0·21	3·55
Hanmer Springs	2·48	8	0·87	4·44
Highfield, Waiau	1·99	4	0·73	3·37
Gore Bay	1·50	8	0·52	2·87
Christchurch	1·65	15	0·34	2·69
Timaru	1·04	7	0·41	1·90
Lambrook Station, Fairlie ..	1·77	4	0·90	2·65
Benmore Station, Clearburn ..	0·08	4	0·05	1·79
Oamaru	0·67	6	0·25	1·74
Queenstown	0·09	4	0·05	2·06
Clyde..	0·14	2	0·08	0·92
Dunedin	2·77	17	0·63	3·01
Wendon	0·77	8	0·16	1·81
Gore	1·57	17	0·33	1·96
Invercargill	3·49	19	0·68	3·28
Puysegur Point	3·36	20	0·70	6·19
Half-moon Bay	4·34	22	0·85	4·41

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

WASHING OUT COWS AFTER CALVING.

"SUBSCRIBER," Ashhurst :—

Would you kindly advise me of a suitable disinfectant for washing cows after calving; and is it necessary to wash all cows

The Live-stock Division :—

The necessity of washing out cows after calving will depend upon each individual animal. If the cow has calved normally at full time with no complications, such as dead calf or retained afterbirth, there is no necessity for washing out the animal. In such cases washing out may be actually detrimental and set up unnecessary irritation. Cows affected with a retained afterbirth, giving birth to a dead calf, or any other complication likely to result in infection of the womb and a chronic discharge therefrom, require to be washed out after calving and treated in such a manner as to prevent a lasting inflammation of the womb. The rubber tubing and other appliances used should be thoroughly washed and scalded before use. The washing-out should be carried out in a hygienic manner, the object being to assist the natural forces of the body to overcome the infection. For this purpose a mild antiseptic solution should be used; strong solutions actually cause irritation and aggravate the condition it is intended to relieve. The water used for preparing the antiseptic solution should be clean water, boiled and allowed to cool before use. The solution should be used at blood-heat. A suitable antiseptic solution may be prepared by adding 1 oz. of Lugol's solution of iodine to a gallon of water prepared as above stated. A hygienic measure which can be commended for all cows is to wash the root of the tail free from all foreign matter and discharge a few days after calving. An ordinary soapy solution may be used in this case.

INOCULATION AND TOP-DRESSING FOR LUCERNE.

"SUBSCRIBER," Kurow :—

I wish to inoculate the soil when sowing an area in lucerne, and will be obliged for information as to the best means of doing so, and the approximate cost per acre. Also is it advisable to top-dress old stands of lucerne with super?

The Fields Division :—

Inoculation for lucerne is best carried out by treating the seed before sowing with a specially prepared culture. This culture is procurable from the Department at the following rates: 2s. per bottle sufficient for 30 lb. of seed, 4s. for 60 lb., 6s. for 90 lb., 8s. for 120 lb. Assuming that you sow at the usual rate of 15 lb. per acre, the cost works out at 1s. per acre. Old stands may be top-dressed to advantage with 3 cwt. per acre of superphosphate in the spring just as the growth of lucerne is beginning, so as to give the lucerne maximum stimulation and avoid as far as possible stimulating grasses and other weeds which possibly are present.

CHECKING INDIAN DOOB GRASS IN LAWN.

FRANK J. REYNOLDS, Whakatane :—

My lawn has become very thick with Indian Doob twitch-grass. I do not wish to break up the lawn. Which do you consider is the best means to check the twitch growth and encourage the lawn grasses?

The Horticulture Division :—

The best treatment for your lawn will probably be to rake it well and break up the mats of Indian Doob. Remove the detached litter and mow the lawn; then apply a top-dressing of the following mixture, which will encourage the growth of the better grasses: 2 oz. bonedust, 1 oz. superphosphate, 1 oz. sulphate of ammonia, ½ oz. sulphate of potash, per square yard. It should be mixed before application with twice its weight of sifted sand or good soil.

The New Zealand

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THE CURD TEST FOR MILK-GRADING.

G. M. MOIR, M.Sc. (N.Z.), A.I.C. (London), Ph.D. (Reading), Dairy Chemist, Wallaceville Dairy Laboratory.

ALTHOUGH all connected with our cheesemaking industry may not be agreed as to the desirability of milk-grading, yet in recent years many more have become converted to the need for progress in this direction. This development has been materially assisted by the success which has attended the introduction of cream-grading. Moreover, in certain districts where special facilities have been available, local enthusiasm has made it possible for milk-grading to be thoroughly tried out, with the result that the factories concerned have been enabled to make more easily and regularly cheese of highest quality. Thus a considerable body of opinion has been developed in favour of it, and no doubt as time goes on the difficulties which stand in the way will be overcome and the principle become firmly established in the experience of all concerned.

The purpose of this article, however, is not to discuss the need for milk-grading. What follows has been written not so much with the object of comparing the curd test with other tests, but rather to set down some of the special advantages which it possesses as a criterion of milk for cheesemaking.

All experienced dairy bacteriologists realize that no one test alone is entirely satisfactory for determining the hygienic quality of milk. After carefully studying information obtained by diverse English, American, and Continental investigators of repute, Dr. A. T. R. Mattick (head of the Bacteriological Department, National Institute for Research in Dairying, Reading, England) writes[1]: "One fact emerges from a consideration of the literature upon the methods at present in use for determining the bacteriological content of milk—viz., no one method is capable of giving exact information as to the numbers of living bacteria present." It follows, therefore, that 100 per cent. efficiency cannot be expected of any test.

Again, it is quite possible that many tests which have been found exceedingly valuable for other purposes—*e.g.*, for control of city milk-supplies—will not necessarily be the best for judging

cheese-milk. Milk for city supply must, among other things, be specially free from souring organisms of the *Streptococcus lactis* type. These very common organisms, however, are of the same type which the cheesemaker grows in his starter culture to add to the milk to enable him to make the best cheese. Consequently, the presence in cheese-milk of a proportion of souring organisms may up to a point be desirable. However, it is not wise to encourage the milk-producer to permit these souring organisms to grow in his milk, because he may easily develop numbers which would spoil the milk for cheesemaking, or at the same time he may easily introduce large numbers of objectionable types.

Leaving aside the question of actual numbers, a test of cheese-milk should, above all, sort out the milks rich in objectionable types of bacteria, such as those which give rise to gassy curds in the vat and subsequent unclean and off-flavours in the mature cheese. This is the special virtue of the curd test, which in fact picks out milks heavily contaminated with organisms of the coliform type.* Dairy bacteriologists have repeatedly emphasized the fact that tests which will reveal the coliform types have an established value for controlling milk-supplies of all kinds. This was pointed out at the World's Dairy Congress, 1928(2) by the late Dr. R. Stenhouse Williams (Research Professor in Dairy Bacteriology at the National Institute for Research in Dairying, Reading, England). Mattick(1) cites experimental evidence from which he concludes: "The presence of coliform organisms in numbers in fresh milk is, therefore, evidence of carelessness at some stage in the handling. In many cases they are of fæcal origin. . . . In the examination of farm samples, therefore, the coliform test is of great value." Tests for coliform organisms in milk are discussed in the latest edition (1928) of the well-known textbook on "Dairy Bacteriology" by Dr. B. W. Hammer, Professor of Dairy Bacteriology at the State College of Iowa, which is one of the principal dairying States in America. He points out(3) that although milk may have a comparatively low total count due to adequate cooling, yet at the same time excessive numbers of coliform organisms may be present due to contamination.

Quite recently Canadian investigators, McGrady and Langevin(4), have emphasized the value of the coliform test as an adjunct to the plate count, which is agreed to be the most reliable method of estimating the numbers of bacteria in milk of the highest quality. They used coliform tests in duplicate, together with plate counts, to discover sources of contamination of high-grade pasteurized milk which in most cases had a plate count of less than 30,000 bacteria per cubic centimetre. They make the following observations: "Both coli-ærogenes determination and plate counts were necessary for the detection of recontamination. Of the two methods the coli-ærogenes

* Organisms of the "coliform type" are so called because they are found in large numbers in the colon or lower intestine of animals. These germs are therefore excreted in the fæces, and consequently cow-manure, dirt, and dust about the cow and the cow-shed are usually heavily infected therewith. Very similar organisms are found associated with the dust of grain and fodder. These organisms are sometimes referred to as the "coli-ærogenes group." Several other names are often used, but throughout this discussion the name "coliform" will be used for simplicity to refer to them.

yielded the sharper, and therefore the more significant, as well as the more consistent results in those cases where the organisms were found."

The same authors also say: "Particular attention is invited to the consistency of the coli results as compared with the plate counts; the latter may vary greatly, but the coli figures are usually maintained from stage to stage. The striking significance of the coli results, where positive, is also in marked contrast to the uncertain significance of many of the differences in plate counts." It is obvious from these results that milk of apparently thoroughly satisfactory sanitary quality can be seriously contaminated with coliform organisms which are located at one or more particular spots in an otherwise clean city milk-bottling plant. Obviously, similar contamination may readily occur in a milking-machine. Mention will be made later of the value of the curd test for detecting such contaminations in milking-machines.

Apart from the value of the coliform organisms as indicators of the sanitary conditions associated with the handling of the milk, the presence of these organisms in cheese milk is particularly objectionable for other reasons. Evidence is available from three distinct sources. First, fundamental researches(5) have shown that *B. coli* will produce chiefly acid and gas in a medium like milk, where in addition to protein there is a fermentable carbohydrate such as lactose (milk-sugar). The organisms do not attack the protein but live on the milk-sugar. If, however, the sugar is removed they begin to attack the protein, which they decompose, producing among other things foul-smelling objectionable substances such as indole and skatole, which have characteristic fæcal odours. Now this is exactly what is liable to occur in cheese, for after a week little milk-sugar is left, and after a fortnight the remainder has completely disappeared, so that the coliform organisms must attack the protein (casein). Second, that this actually occurs in cheese has been proved beyond doubt by experiments carried out by Dr. Whitehead, Bacteriologist at the Dairy Research Institute, Palmerston North. In these he added to pasteurized milk heavy doses of coliform organisms prior to using the milk for cheesemaking. On different days different coliform cultures were used, and each day control cheeses were made from the same pasteurized milk without the addition of these particular organisms. In both cases the usual amount of starter was added to each vat. In spite of the large inoculation with gas-forming bacteria the experimental cheese showed no sign of gas-holes, but, what is much more important, all developed objectionable off-flavours, variously described as "unclean," "cowy," "like putrid meat." Moreover, these off-flavours were more pronounced when the experimental cheeses were more mature, but were entirely absent from the control cheese to which no coliform organisms had been added. Third, the evidence obtained from the two foregoing lines of fundamental research in effect only confirms what has long been realized by experienced and observant cheesemakers, who well know that gassy curds are liable to make cheese which develops off-flavours while maturing.

In the modern literature of dairy science comparatively few references are to be found to the curd test, because in the laboratory

examination of milk a more refined coliform test is available. In his textbook on "Dairy Bacteriology" Hammer emphasizes the value of the Wisconsin curd test, which was introduced at the end of last century. After describing the method of obtaining the pat of curd he says: "If it is solid throughout, shows no sliminess at the surface, and has an agreeable odour, the milk was probably free from organisms that would be objectionable in cheesemaking, while gas-holes in the curd, sliminess, objectionable odours, &c., show the presence of organisms that can be expected to cause undesirable conditions in cheese; in some instances the curd is so full of gas-holes that it may be spongy. Milk with a very high bacterial count may give a desirable type of curd and another lot with a low count may give a very undesirable curd, so that the test is of no value in comparing samples of milk from the standpoint of their keeping-quality."

In 1929 I visited the South German Dairy Research and Experiment Station at Weihenstephan, which is ten or twelve miles distant from the nearest town, Munich. This institution is part of a large and old-established agricultural experiment station which is surrounded by typical Bavarian farm-lands where for centuries agricultural pursuits, including buttermaking and cheesemaking, have been carried on. I was fortunate in meeting there the dairy bacteriologist, Dr. K. J. Demeter, who has had considerable experience both in Germany and in America. When the subject of the grading of cheese milk was discussed he introduced one of his assistants, who explained to me a curd test which they have developed for judging the suitability of milk for cheesemaking([7]). This test, called the "rennet curd test" (*labgarprobe*), they regard as the most important for this purpose. A full account of this curd test and other simple tests for milk-grading has recently been published by Zeiler and Berwig in a German journal* dealing with dairy science([8]). The authors have subjected the curd test, with various modifications, to a very exhaustive examination and comparison with other tests. For a period of three years milk used for cheesemaking has been regularly examined, so that hundreds of comparisons are available; for example, the results of 7,564 comparisons between the curd test and fermentation test are tabulated.

The curd test used by Zeiler and Berwig is carried out by adding to 50 c.c. of milk 2 c.c. of a fresh suitably diluted rennet solution. The tube containing the milk is set for twelve hours in a water bath at a temperature of 102° F. The curd is then removed from the whey, cut, and examined for form, texture, and flavour. They point out that a similar test was introduced about the year 1888 by Bumann, who cut the curd to drain off the whey and used a kind of mould box in which to collect it to form a "little curd." Owing to its bothersome nature Bumann's apparatus was little used and for many years was quite forgotten. Essentially the same principle is used in the Wisconsin curd test, which also is tedious to operate in large numbers. However, by means of the apparatus known as the "New Zealand curd test," elaborated by Messrs. Singleton, Morgan, and Syron at the Wallaceville Dairy Laboratory, a great deal of time and trouble can be saved([9]).

* I am indebted to the Dairy Research Institute for the loan of this journal in order to enable me to translate the article.

The temperature of 100°–102° F. used for the curd test has a special significance, for it is recognized that coliform bacteria grow faster than do the lactic-acid bacteria at this temperature, in the vicinity of which the cheesemaking operations are conducted. It is therefore fair that a test for grading milk for cheesemaking should make the conditions of temperature favourable for discovering the influence exerted by the coliform organisms upon the manufacture and subsequent ripening of the cheese.

The unquestioned superiority of the rennet curd test was established by Zeiler and Berwig in forty-eight experiments in which cheese was made from the same milk, which was judged both by the fermentation test and the rennet curd test. The properties of the little curds from the latter definitely agree well with cheese prepared from the same milk, especially in respect to the porosity (holes) of the material. Further, many tests show that not only the fresh cheeses but also the ripe ones show good agreement with the little curds.

A point in favour of the German rennet curd test (where the curd remains uncut in the whey) is that it can be done with rather less milk. Sometimes, owing to gassy fermentation, the uncut curd assumes peculiar shapes, but any difficulty in judging the results on this account can soon be overcome after a little experience. These peculiar shapes usually occur in curds which contain so much gas that they float to the surface and so become crumpled up. By using Bumann's apparatus with mould boxes the German scientists obtained little curds of a similar form, which, in their opinion, provided a better comparison of different milks than did their rennet curd test.

A further improvement is provided in the time saved by the New Zealand curd test apparatus, which from varying milk provides for comparison a set of curds of practically the same shape. On this basis, therefore, more satisfactory results are to be expected than even with the German rennet curd test, the superiority of which has already been established. The German investigators consider these similar forms an especial advantage if the milk-tests are to be explained to the producers. In using the Wisconsin curd test officers of the Dairy Division also have for many years found it an advantage to be able to show suppliers the difference between various curds. Emphasis is to be placed upon the similarity between the operations of obtaining the test curd and those which take place in the cheese-vat. Thus the cheesemaker can detect and explain to suppliers those types of milk which will give objectionable curds in the cheese-vat (whether due to the bacteriological or to the chemical condition of the milk). The curd test is of special value for detecting curds which are slimy or which may develop objectionable odours, either in the vat or at some subsequent stage.

It has already been pointed out that no one test alone can be relied upon for eliminating without fail all faulty milks. For this reason the use of the methylene blue test as an adjunct to the curd test has been advocated in New Zealand, with the object of discovering those milks which are heavily contaminated with souring

organisms. Here, too, the experience of officers of the Dairy Division is confirmed by that of the German investigators, who have studied the matter very thoroughly. These investigators made tests of nearly five hundred samples of milk by the reductase test, the reductase-fermentation test, and the reductase-curd test. They found that the presence of the methylene blue does not interfere with the curd test. In the Bumann test or the New Zealand curd test, where the curd is cut to drain the whey, the methylene blue test of course cannot be observed after cutting (about forty-five minutes after rennetting). But in the curd test as used by the German scientists the curd remains uncut in the whey till the final examination (twelve hours or more). Some separation of the whey occurs usually after about one and a half to two hours, and renders rather difficult the judging of the time when the blue colour disappears. The difficulty is overcome, however, if the colour of the curd but not of the whey is observed. There can be no doubt that the methylene blue test is a valuable adjunct to the curd test.

The suggestion has been made that the methylene blue test can be easily falsified by adding certain chemicals to the milk. This may be true, but at the same time any farmer who attempted to do this regularly would find it a rather expensive business. The expense and trouble would give much better results if devoted to the heating and use of more boiling water and steam for cleaning the utensils. Experiments have been carried out at the Wallaceville Laboratory with various substances capable of preventing the rapid decolourizing of methylene blue in bad milks. These experiments have shown that even though such milks appear better under the blue test they are usually condemned by the curd test.

Milk-producers who regularly clean their plants well are occasionally tempted to overlook the cleaning after the evening milking. When this has once or twice been done without arousing complaint about the quality of their milk they may do it more often. Sooner or later such producers deliver milk of two qualities—the evening's milk being quite satisfactory, while the morning's milk is the reverse.

This remarkable state of affairs is most likely to happen after a warm night, especially if arrangements have been made to cool the evening's milk quickly and thoroughly. If the machine has not been cleaned the traces of milk left in it enable the germs to multiply enormously during a warm night, and still further rapid multiplication will occur in the warm morning's milk before delivery to the factory. When the condition of the milk is ascertained by means of the curd test, with or without the methylene blue test, such a state of affairs is easily explained and rectified. Experiences like this are a warning that the cooling of milk which is so necessary in warm weather cannot in any way replace thorough cleaning of the machines and utensils.

Officers of the Dairy Division who have had a lengthy experience of the curd test have frequently found it useful in detecting faults in the cleaning of milking-machines and utensils. Here again confirmation comes from the Weihenstephan Experiment Station; in

one case by means of the curd test alone the trouble was traced to dirty cans, and when they were thoroughly washed and steam-sterilized the trouble disappeared. Further investigation disclosed the fact that the cans were infected on the farm by means of the water employed from a spring. This information was also obtained by means of the curd test. For this purpose the diluted rennet used was in one case prepared with the suspected water and for comparison with sterile (boiled) water. Both rennet solutions were used to curdle separate tests upon high-quality milk, and significant differences were obtained pointing to the water as the cause of the trouble. At Weihenstephan a badly cleaned milking-machine was detected by performing curd tests upon the first milk to pass through it and upon the last milk. The first milk gave a bad test, but after a number of cows had been milked the passage of the milk washed away many of the contaminating organisms, so that the last milk gave a much better curd test.

In this and other similar investigations Zeiler and Berwig stated that only the curd test, in agreement with bacteriological findings, signified the presence of an infection, while all other simple tests had allowed the quality of the milk to appear unobjectionable. It is unfortunate that they do not publish their bacteriological findings, as comparatively little information is available in this connection. Where facilities permit it would be interesting and instructive to obtain some comparisons between the results of curd tests and laboratory methods for determining numbers and types of bacteria. On the basis of what is already known about discrepancies between various tests, correlation is to be expected with the majority of milks; in a few cases the curd test will discover faults passed by other methods, and conversely in a few other cases. However, by using the curd test together with other tests, such as the methylene blue, very few faulty milks should be passed.

The German scientists, after using a set of simple milk-quality tests for three years, state that they are so impressed with the value of the curd test that in the fourth year they propose to increase the points allotted to it from ten to fifteen, while no other test is allotted more than five points[10]. They regard the test as the best for judging "the suitability of milk for cheesemaking," which, according to their investigations, is the property of milk most difficult to improve.

What has been written suffices to show that the curd test is based upon a firm foundation both generally and particularly. In general the presence of numbers of coliform organisms in milk is evidence of careless handling at some stage; in particular these organisms can very easily cause serious damage and loss to the cheesemaking industry. So long as there are coliform organisms in milk the curd test is never likely to become obsolete. For practical purposes this method of examining milk has undoubtedly stood the test of time, and if conscientiously and regularly used will no doubt help materially to improve both the quality of the milk used for cheesemaking and consequently the quality of cheese exported from New Zealand.

I wish to express my indebtedness to Mr. W. M. Singleton, Director of the Dairy Division, for his assistance in preparing this article. His

criticism and suggestions have been particularly valuable in enabling me to correlate known scientific facts with the observations and experience of practical cheesemakers.

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SPREAD OF *PIERIS RAPAE* BUTTERFLY AND PROGRESS OF PARASITE WORK.

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IN the June, 1931, issue of this *Journal* the writer gave an account of *Pieris rapae*, commonly known as the white or cabbage butterfly. It was there mentioned that *Pieris rapae* was first noticed at Napier in 1930, and that in October of the same year it was very plentiful in that locality. In the present article it is intended to refer to the spread of this insect and to give a short account of the progress with the natural enemies introduced.

The 1930–31 season was marked by a rapid increase of the butterfly, so much so that by the end of the season the insect was common in every domestic garden in Napier, Hastings, and the surrounding districts. The 1931–32 season was noteworthy on account of a further increase and spread of the insect. Not only did it increase enormously in the Napier-Hastings area (see shaded portion of map, Fig. 1), being common along the roadsides and fields, but it also spread at least 130 miles from the initial point of infestation. The other places shown on the map represent widely separated localities where the butterfly has been found. They are most likely the farthest points which the butterfly has reached since it first became established at Napier.

When a brief survey of the position was made during the latter part of the past season it was very noticeable that the further one travelled from Hastings on the road south through Dannevirke and towards the Manawatu Gorge, the less prevalent the pest became. Whether the rapid spread of the insect was wholly due to its migratory powers seems questionable; certainly from Hastings to near the Gorge spread was by natural means, but whether in other directions it flew across the intervening ranges or was taken through by human agency is a moot point. It is interesting to note, however, that there were various simultaneous initial points of infestation on the western side of the ranges, suggesting spread by migration. The insect has been noted as far south as Timaru, but as this is the only locality in the South Island from which it has been reported, it is clear that spread in this case was by human agency.

Destructiveness of Pieris rapae.

Although a good deal has been said about the destructiveness of *Pieris rapae* it became clear after surveying the infested area that most of the injury to cruciferous crops was due more to the old enemy diamond-back moth. *Pieris rapae* is conspicuous both in regard to its size and its habits, and on account of this it received more than its fair share of the blame for crop injury. It is, however, very destructive to cabbages and readily attacks both rape and chou moellier. The writer has not had the opportunity yet of observing its attacks on other cruciferous crops.

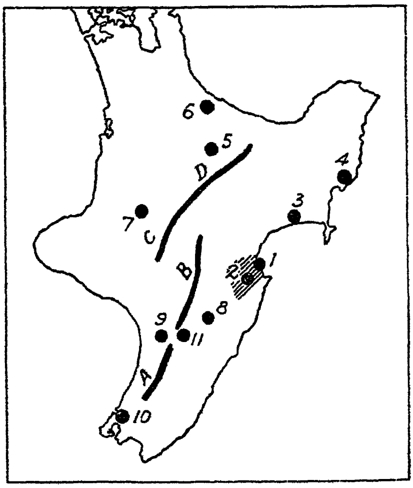

FIG. I. MAP SHOWING SPREAD OF PIERIS RAPAE IN THE NORTH ISLAND.

(1) Napier, (2) Hastings, (3) Wairoa, (4) Gisborne, (5) Waiotapu, (6) Te Puke, (7) Taumarunui, (8) Dannevirke, (9) Palmerston North, (10) Hutt, (11) Manawatu Gorge. A B and C D—Mountain ranges.

Parasite Introductions.

In the earlier article already referred to mention was made of two important parasites of *P. rapae*—namely, *Pteromalus puparum* and *Apanteles glomeratus* (Fig. 2). In response to requests to the Imperial Institute of Entomology, London, a supply of pupæ of the latter insect was sent out, and the following notes deal with the progress of this work since receipt of the material. Two parasites had emerged when the material was unpacked; the remainder were placed in emergence boxes, and the adults as they emerged from time to time were placed in large test-tubes and fed on raisins for a short period. Mating took place readily under these conditions, and the parasites were then liberated in small cages containing potted cabbage-plants well infested with *P. rapae* larvæ. The most successful method of rearing them under artificial conditions was to confine them as closely as possible with an abundance of the host on its natural food plant. Liberations in a large space, such as an insectary, even in the presence of an abundance of hosts, appeared to be wasteful, as a large number flew to the roof of the insectory and little parasitization took place.

Only the early stage larvæ were parasitized. A female in search of hosts for oviposition was observed to hover near the under side of a leaf where first and second stage caterpillars were situated. Shortly after alighting it was observed palpitating its antennæ on what was apparently a suitable host, as oviposition immediately followed, the ovipositor being inserted in segments of the posterior third of the larva.

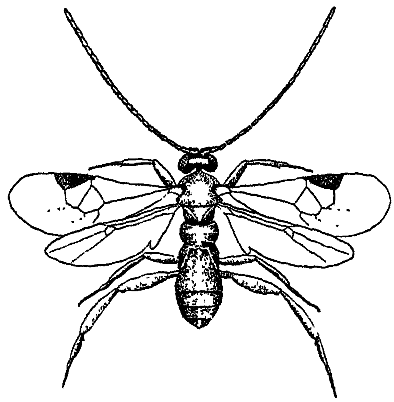

FIG. 2. APANTELES GLOMERATUS, PARASITE OF PIERIS RAPAE. × 7 APPROXIMATELY. [Original

FIG. 3. PARASITE COCOONS. × 3½ APPROXIMATELY. [Photo by H. Drake.

Very little movement of the host was noted. Older caterpillars resisted attacks by throwing the anterior portion of the body backwards whenever a parasite touched them.

Under glasshouse conditions parasite larvæ emerged from the host from twenty to twenty-eight days following oviposition. The number emerging from one host varied considerably, though there were seldom less than eighteen and occasionally as many as fifty. In the earlier stages there appeared to be no difference between the parasitized and unparasitized larvæ, but in the older caterpillars those parasitized were

readily recognizable owing to their lighter green colour. This condition was most noticeable in the posterior half, where the main proportion of the parasite larvæ completed their development. On close examination the small whitish-coloured parasites could be observed moving beneath the host cuticle.

The emergence of the parasites took place after the host had migrated and settled down in some place suitable for pupation. All parasites within the host apparently completed their development at approximately the same time, as once emergence started they seemed to all leave as fast as possible, protruding themselves from a dozen and more places at once from the unfortunate host, which could live for a short period following parasite emergence but was not observed to pupate. Immediately following emergence the parasites spun their small silken yellow cocoons and settled down to pupate. While each spun its own separate cocoon these rarely occurred singly. On the contrary they were glued together in a bunch (Fig. 3). The habit of *Pieris rapae* in finding some clean place to pupate appeared to favour the parasites, as under these circumstances they were better able to form their cocoons. Should the host fall on to loose dusty ground to pupate the parasites are distinctly handicapped when subsequently emerging to spin their cocoons.

From the 2,500 parasite pupæ received from abroad 1,200 adult parasites emerged. Of these, 870 were used for parasitizing *Pieris rapae* under glasshouse conditions, 270 died in the emergence boxes, and sixty were liberated in the field. Mating had been observed to take place before field liberations were made. Under favourable conditions the adults lived ten to twelve days.

Most of the parasites reared under glasshouse conditions are being held in cold storage for liberation during the present season (1932–33). These will be liberated in only one or two selected localities and will not be available for wide distribution. Should the concentration of the parasites in one or two infested areas in this manner prove successful, and should they become well established in these areas, then a gradual extension of the work would be systematically adopted.

Wheat Certification.—The second annual report of the Wheat Research Institute, recently published, refers to this subject as follows: "The certification of crops of wheat as suitable for seed has been continued by the Department of Agriculture in consultation with the Institute. New standards of purity and freedom from disease have been adopted, and crops are passed for certification only if they contain less than 0·2 per cent. of impurities and less than 0·1 per cent. of loose smut. 3,289 acres were entered for certification, and 385 acres were finally certified. The average quantity sold in past years has been about 15,000 bushels, and there is no doubt that the constant feeding into the market of this quantity of pure seed has been the chief cause of the high standard of purity now found in commercial lines of the common types of Canterbury wheat. Any purchaser of certified seed has the right to apply to have his resultant crop inspected for certification. One recent result of certification has been the very large replacement of College Hunters by College Hunters II—a somewhat superior strain. The original College Hunters had become impure entirely through accidental crossing. It is becoming increasingly obvious that natural crossing will prevent any wheat (except Solid-straw Tuscan) from long continuing pure enough to reach the certification standards, and that the continual supply of new pure strains, now undertaken by the Department of Agriculture at Lincoln, will always be a necessity. The certification of farmers' crops is to be regarded as the final link in the chain of operations for improving the yield and quality of the wheats of the country."

TOMATO LEAF-MOULD (*CLADOSPORIUM FULVUM*).*

E. E. CHAMBERLAIN, Mycological Laboratory, Plant Research Station, Palmerston North.

LEAF-MOULD is one of the most troublesome diseases of glasshouse tomatoes in New Zealand. It is of world-wide distribution, and causes extensive damage to tomato crops throughout Europe and North America. The disease has been present in New Zealand for many years, being first recorded by Kirk in 1897, as causing losses in tomato crops, especially under glass. The disease is confined to tomatoes, and in this country is of economic significance in the glasshouse only.

SYMPTOMS.

Leaf-mould is typically a disease of the foliage, but it may attack the flowers (Makemson, 1919; Small, 1930, *a*) and has been recorded as attacking young tender stems. It appears first as a small downy patch on the under side of the leaf (Fig. 1). Under favourable conditions this rapidly enlarges, and the colour changes to pale buff and finally to a tawny-brown. As the lesion enlarges, the margin advances as a downy white band, while the brown centre assumes a velvety appearance. The development of the lesion on the under side of the leaf is accompanied by the formation of a yellow area on the upper surface. As the disease progresses this yellow area deepens in colour, finally becoming reddish-brown when the leaf tissue is quite dead. With the death of the tissue the lesion on the lower surface often becomes purple in colour. Infection often takes place at a number of points on the leaf, and as the lesions enlarge they coalesce and the whole leaf soon dies and falls off. Occasionally the upper surface of the leaves show scanty growth of the fungus. The lower leaves are usually the first to show infection, and from these the disease gradually spreads upwards.

Flowers are also attacked. Infection of either the calyx or the ovary may occur, and a flower thus attacked fails to develop and falls from the plant (Makemson, 1919; Small, 1930, *a*).

It has been considered by most workers that the disease is confined to the leaves, flowers, and young stems, but Gardner (1925) recorded it as causing a black-rot of the fruit. This form of the disease, however, is unknown in New Zealand.

ECONOMIC IMPORTANCE.

Leaf-mould occurs among glasshouse-grown tomatoes throughout New Zealand. The intensity of attack varies with the seasons, and in some years, especially in the South Island, it is not of economic significance. The extent of the damage depends largely upon the stage of growth of the plants when the attack occurs.

* This is the first of a series of articles covering the tomato diseases present in New Zealand. Each article will deal with a specific disease, and will give particulars of its appearance, cause, and remedial treatment.—Ed.

If the plants become infected while they are still young the greater part of the crop may be lost. This, however, seldom occurs. In New Zealand, glasshouse tomatoes are usually planted in July. The conditions are such that for the first three months there is rarely any infection with leaf-mould. With the occurrence of warm wet weather in November, however, the disease may appear and considerably damage the crop. This may take place when the main portion of the crop is about to ripen, and although the fully grown fruit will develop normally the younger fruit will not develop to full size. Moreover, the flower trusses developing from this time onwards usually fail to set fruit. This may be due either to lack of vitality of the plant brought about by the death of leaves or by the direct attack by the fungus on the flowers. Even in glasshouses where the humidity has been carefully

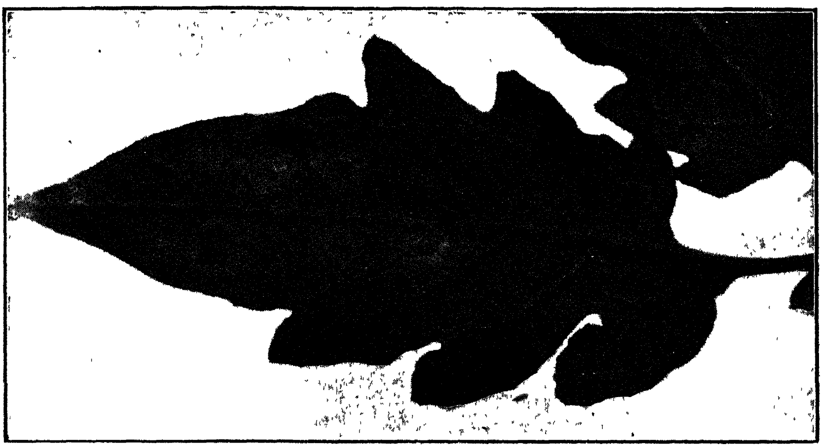

FIG. 1. LEAF-MOULD ON TOMATO LEAF.

Lesions at an early stage of development on the under side of the leaf. The centres of the lesions are just beginning to turn brown.

[*Photo by H. Drake.*

controlled it often happens that the disease makes its appearance at the end of the season. An attack at this stage does not interfere with the ripening of the fruit, so the loss is not great.

Life History of the Causative Organism.

Makemson (1919) proved that tomato leaf-mould was caused by *Cladosporium fulvum* Cke., a member of the Dermatiaceae of the fungi Imperfecti. This has been verified with New Zealand material.

A spore alighting on a leaf will germinate if the temperature and humidity conditions are favourable. The spore may produce one or more germ tubes which develop to form a superficial mycelium, the hyphæ of which are septate and branched. As the fungus spreads over the surface of the leaf the hyphæ enter any leaf stomata with which they come in contact. After gaining entrance through the stomata the fungus rapidly spreads through the

parenchyma and palisade tissue of the leaf, forming a mycelium. The hyphæ, which are still septate and branched, grow in between the cells and also penetrate into them. The mycelium aggregates at the stomata on the lower surface of the leaf, where it forms dense mats of interwoven hyphæ termed stromata. From these stromata arise the fertile hyphæ (conidiophores), which are four to eight septate and carry the spores (Fig. 2). The spores are coloured slightly, are irregular in shape and size, and may be either continuous or one septate. The conidiophores emerge from the stomata in tufts, which are so compacted that they coalesce at the tips to give an appearance of a continuous mat of hyphæ.

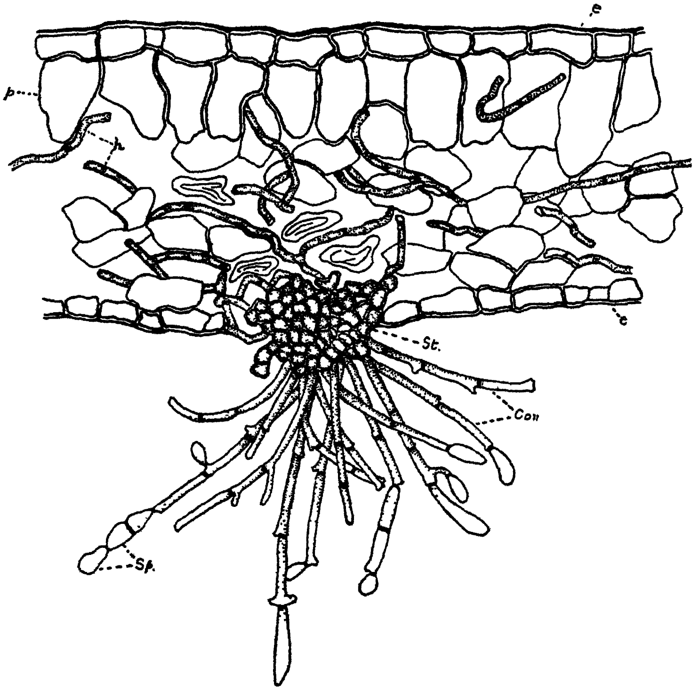

FIG. 2. SECTION THROUGH INFECTED TOMATO LEAFLET × 320.

(*Con.*) conidiophores; (*e*) epidermis (cuticle indicated by heavy line); (*h*) hyphæ; (*p*) palisade cells; (*sp.*) conidia (spores); (*st.*) stroma.

[*Original.*

Infection may take place on either the upper or under surface of the leaf, but fructification almost invariably takes place on the under surface. The hyphæ penetrating the leaf tissue obtain nourishment for the production of the fructifications from the plant cells. These cells are soon killed and turn brown. As the fungus spreads, more and more cells die, until the whole leaf is killed and the lower surface completely covered with fructifications. Under favourable conditions infection may be observed six or seven days after a spore has settled on a leaf, and within ten days abundant spore formation may have taken place.

Immense numbers of spores are produced even from a single lesion. They are readily detached from the conidiophores and are carried by air currents from one end of a glasshouse to the other, leading to rapid infection of the whole crop. The spores in a dry condition are capable of remaining viable for at least twelve months. The spores from an infected crop must be harboured in large numbers by the walls and window-sashes of a glasshouse, and it seems probable that these overwintering spores are a source of infection for the following season's crop.

Factors affecting Infection and Growth of the Fungus.

The two main factors affecting the infection of tomatoes by leaf-mould are humidity and temperature. Of these humidity has the greater significance. The humidity-temperature relationships have been worked out by Small (1930, *b*) and Van der Meer (1931), Severe infection may occur at 50° to 60° F., provided the humidity is sufficiently high, but at these temperatures the disease develops very slowly. For infection and subsequent development of the fungus humidities above 90 per cent. are very favourable, and the optimum temperature is 72° F. At this temperature infection is severe at 80 per cent. relative humidity and rare at 70 per cent. The lower the temperature the greater must be the relative humidity for infection to occur. A fairly high humidity is also essential for rapid development of the disease, and at 64° F. the growth of the fungus is retarded at 80 per cent. humidity.

From a consideration of these facts it may readily be seen why the disease occurs to such an extent in glasshouses. When a glasshouse is closed down the moisture given off by the growing plants is confined in the house and the relative humidity increases. Further, there is little air movement, so that high local humidity is likely to occur in the vicinity of the actual plants. This is particularly the case when plants are grown close together and possess abundant foliage at their bases. In such cases the relative humidity at the surface of the lower leaves of the plants often approximates 100 per cent. (Guba, 1930), and if high temperatures are prevailing the conditions for infection and development of leaf-mould are ideal. Any movement of the air will result in the replacement of the humid air surrounding the leaves by air having a lower humidity. Consequently air movement plays an important part in keeping down local humidity. The relative insignificance of leaf-mould in the field under New Zealand conditions may be explained by the almost constant air movement tending to decrease the relative humidity in the vicinity of the plants.

When the temperature in a closed glasshouse falls below the point where the air becomes saturated with water vapour the moisture condenses on the glass. This leaves a large surface from which evaporation may take place, so that even when the temperature begins to rise again the air remains nearly saturated for some time. Small (1930, *b*) has shown that low humidity occurring during the day is not sufficient to keep down infection if humid conditions prevail for several hours each night.

Light also has a marked detrimental effect on the fungus in that it retards its growth (Makemson, 1919). This effect may be responsible

in part for the growth of the fungus on the under surface of the leaves, and also for its more ready development on the lower leaves.

The condition of growth of the tomato plants also plays a part in the infection and development of leaf-mould. Excessive watering produces soft succulent plants which are highly susceptible to the disease. This may in part be accounted for by the fact that respiration is greater in these plants, so that a greater local humidity is developed. Also the stomata are much more numerous, with the result that infection takes place more readily. Plants grown in the open have fewer stomata than those grown in the glasshouse.

Preventive Measures.

(a) Cultural Methods.—To check infection and development of leaf-mould on tomato plants the humidity should be kept as low as possible, the temperature as much below 72° F. as is practicable, and excessive watering avoided. Both the relative humidity and the temperature may be lowered by adequate ventilation, and the incidence of the disease may be governed by this means. As November approaches, warm weather with humid conditions may be expected, and careful attention should be paid to ventilation. As much ventilation as possible consistent with the maintenance of an even temperature should be given on all occasions. To prevent the temperature from falling too low it is necessary to keep the ventilators closed at night, but an endeavour should be made to open them as early as possible in the morning. Although a maximum of ventilation is advocated a direct draught on to the plants must be avoided, since this may cause chilling of the plants, with the result that the young flower trusses fail to set fruit. Thus care should be taken to open the ventilators on the side of the house away from the wind, and any change of wind should be noted and the ventilators altered accordingly. On hot days it may be necessary to open the doors, in which case, unless the weather is very calm, scrim should be placed over the doorways to prevent a direct current of air through the house. Circulation of air between the plants is aided by a judicious pruning of the leaves at the base of the plant, and by avoiding close planting.

Watering should be carried out early in the day, and as far as possible on fine days only. During dull weather it should be reduced to a minimum and should not be excessive at any time, since too much water produces soft susceptible plants and also tends to raise the humidity. If it is the practice to spray the leaves with water this should be done only on fine days.

Light also plays its part in controlling the disease, and the planting should be carried out so as to allow the maximum amount of light to reach each plant. The above-mentioned pruning of the lower leaves will also aid in allowing light to reach all parts of the plants.

(b) Spraying.—There have been many reports that sprays have failed to give control of leaf-mould, and as a result some workers do not recommend their use (Guba, 1929). The usual practice in this country is to spray with bordeaux mixture. It has been shown recently (Small, 1931) that neither bordeaux or burgundy are effective against this disease. Ammonium copper carbonate alone among the copper sprays has been reported as giving good control, but it has been found that under New Zealand conditions this spray causes a certain amount of leaf injury.

Sulphur in its various forms and also sulphur compounds have been found to be particularly toxic to the leaf-mould fungus, and a number of sulphur treatments have been used in attempts to control the disease. Vaporization and dusting with sulphur, and spraying with lime-sulphur, precipitated sulphur, and colloidal sulphur have all been tested (Guba, 1929; Small, 1931). It would appear from the evidence available that of these the colloidal sulphur is the most efficient. Lime-sulphur also appears to have given a good measure of control, but has been found to produce spray injury. If good results are to be obtained with any treatment the latter must be applied immediately on the first appearance of the disease. The reason for this will be readily realized when it is understood that no treatment can directly combat the disease, but can only protect the leaves against further infection. Partial success only will be secured if wrong sprays are used, or spray applications made after the disease has become thoroughly established in the glass-house.

Growers of glasshouse tomatoes in New Zealand are recommended to spray with sulphur, preferably of the colloidal type. The standard recommendation for strength of colloidal sulphur is 4 lb. of paste per 100 gallons of water. It is possible that under glasshouse conditions this strength is greater than necessary, and that a spray mixture as low as 2 lb. per 100 gallons may be effective against the disease. The time of application of the spray is more significant than its strength. If the disease appears early in the season fortnightly applications are advised, but later in the season the intervals may be extended to three weeks.

Disinfection of Empty Glasshouses.

The disease is able to overwinter by means of spores which have lodged in various parts of the glasshouse. Thus a thorough disinfection of the glasshouse before the new season's crop is planted will aid in keeping down infection. Fumigation (Small, 1931; Van der Meer, 1931) has been shown to be the most satisfactory way of disinfecting glasshouses. The two gases which have been found to be consistently effective in killing the spores are formaldehyde and sulphur-dioxide.

Before attempting to fumigate, the glasshouse must be sealed down as completely as possible. To obtain the best results from fumigation the gas should be generated at a number of points. Sufficient formaldehyde gas to fumigate 10,000 cubic ft. of glasshouse space may be generated by adding 2 pints of 40-per-cent. formalin to 1¼ lb. of potassium permanganate. Equal portions of the potassium permanganate are added to four deep receptacles placed at different points in the glasshouse and one-quarter of the total formalin poured into each. To fumigate with sulphur-dioxide screened agricultural sulphur is burned at the rate of 10 lb. per 10,000 cubic ft. It is merely spread out in five or six heaps on the floor of the glasshouse and then ignited. The sulphur is readily ignited after pouring a small quantity of methylated spirits on the centre of each heap. At the above concentrations formaldehyde and sulphur dioxide have practically equal efficiency in killing spores of the leaf-mould fungus, while the cost of application of the two treatments is approximately the same.

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COMMERCIAL FERTILIZERS AND THEIR BASIS OF SALE.

V. INORGANIC NITROGENOUS FERTILIZERS (*concluded*).

J. A. BRUCE, Inspector of Fertilizers, Department of Agriculture, Wellington.

2. By-product Sulphate of Ammonia.

COKING coals containing about 1½ to 2 per cent. of nitrogen are a useful source of by-product sulphate of ammonia, and in certain industries, particularly those which are dependent upon very large quantities of coke or coal for manufactures, it has been a customary practice since the end of last century to recover this fertilizer salt as a main by-product.

The chief sources of supply are city gasworks, coke-ovens, iron and steel works, &c.; comparatively small quantities also are available from the shale and peat industries. For a great number of years the sulphate of ammonia sold in New Zealand was of the by-product type from such above-named sources in Britain, Australia, and the United States of America, and it is only recently that it has been largely replaced by the synthetic sulphate, more especially from the Billingham (England) air-nitrogen factory. In the destructive distillation of coal for the production of illuminating gas, for example, about 22 lb. to 25 lb. of sulphate of ammonia per ton of coal is recoverable during the purification of the gas. An improved method, however, known as the Mond gas process, may be instanced as recovering very much larger quantities. This method consists in blowing in air and steam during the destructive distillation operation, and the sulphate of ammonia recovery is 75 lb. to 85 lb. per ton of coal. In the coke-ovens of the more modern type, using the direct process, the ammonia gas driven off with the other gases in the heating of the coal is passed through dilute solutions of sulphuric

acid, and the sulphate of ammonia is crystallized out. In the older-class of coke-oven plant and in gasworks retorts crude ammoniacal liquor is obtained by literally scrubbing the ammonia gas from the coal with water. The liquor is then treated with lime before being absorbed into sulphuric acid in order to produce the sulphate salt.

By-product sulphate of ammonia has much the same fertilizing-power as the synthetic article; its percentage of water-soluble nitrogen being about 20·6 or 20·8 (461 lb. or 466 lb. per ton). In some cases the synthetic compound may be a trifle more pure and in better physical condition, but, on the whole, the modern product from both sources is of a white crystalline nature, leaving practically no noticeable residue when dissolved in water.* Actually the chemically pure form of sulphate of ammonia contains 21·2 per cent. of nitrogen, so that the margin of difference allowable for moisture and impurities in the commercial article is exceedingly small. Thus the material now on our market can be rated as containing about 98 per cent. sulphate of ammonia.

The difference in colour of consignments of sulphate of ammonia has now and then caused interest, or even suspicion, among purchasers. Formerly it was not unusual to see this salt in the fertilizer-bag either as a grey, yellow, or blue colour, its grey or yellow appearance arising from the presence of a little tarry matter, and the blue colour to a trace of ferro-cyanide. These impurities responsible for the colour variations are present in such minute quantities that the efficiency of the fertilizer could not be impaired in any way.

In the first section of the present article reference was made to the fact that a few grades of by-product sulphate of ammonia may happen to contain certain minor amounts of free sulphuric acid, sufficient to cause serious lumping and bag-rotting. Now under the English fertilizer law the percentage of free sulphuric acid must be declared on the invoice certificate delivered to the purchaser. This is a requirement additional to the statement of the percentage of nitrogen in the case of inorganic nitrogenous products, for which a margin of error of 0·3 per cent. is permitted either above or below the actual figure guaranteed. The New Zealand Fertilizers Act provides a similar limit of variation of 0·5 per cent., but the former provision is not needed here, as our deliveries are from large modern works equipped to make a dry, neutral article with only the very slightest trace (under 0·025 per cent.) of free acid in its composition. There is one point, however, local purchasers might bear in mind in reference to the guarantee of nitrogen. Occasionally this may, for example, be given as 19 per cent. on the invoice certificate, while the bags may carry an inscribed claim of 20·6 or 20·8 per cent. Should this be noticed the matter might well be reported to an Inspector under the Fertilizers Act for investigation.

* The purity of sulphate of ammonia can be tested in another way by heating a little on a shovel at a dull red heat; if any appreciable residue is left the material is not of the requisite purity.

ECONOMIC UTILIZATION OF BY-PRODUCT SULPHATE OF AMMONIA.

Prior to the general development of synthetic nitrogen processes the sulphate of ammonia on the market was of by-product origin, its demand being largely linked up with the demand for coal or coke. It soon became recognized, however, that the by-product supplies from coke-ovens, ironworks, gasworks, &c., would in time be insufficient to cope with the ever-increasing agricultural, industrial, and military demands for nitrogenous compounds, and, like the Chilean nitrate-fields, this source of supply could only be supplementary to the expanding air-nitrogen industry. To-day the latter branch alone is quite capable of economically supplying the world's inorganic nitrogen needs, and in the face of strong competition by-product sulphate of ammonia plants in many instances have experienced very great difficulty in selling their product at anything like a profit. Thus the problem of the more economic employment of the plentiful supplies of crude ammoniacal liquor at large numbers of gasworks has become one of the first magnitude.

It has been suggested to employ this raw liquid by-product on the land direct as a liquid manure, but it is obvious that handling and distribution would be awkward. Notwithstanding the difficulties in this particular direction, a certain amount of anhydrous and aqua ammonia derived from the ammoniacal liquor can be absorbed into superphosphate. Considerable quantities of what is usually termed ammoniated superphosphate are marketed annually in countries, such as the United States, where large quantities of both by-product and synthetic ammonia are available. Later on in this country it may be feasible, as an outcome of the research work now in progress in Britain and elsewhere, to utilize the crude ammoniacal liquor, at present discarded at the various gasworks, for fertilizer manufacture.

3. Nitrate of Soda from Natural Deposits.

The discovery of vast deposits of naturally occurring nitrate of soda in Chile in 1830 marked the beginning of a great industry, which, until the comparatively recent large-scale developments in synthetic nitrogen production took place, dominated the world's nitrogen markets. Although this supremacy is no longer retained, the industry after a century of operation still commands a position of some importance in the international nitrogen field.

The modern operations of mining have been principally confined to five main fields, situated in the exceptionally barren, arid region lying at from 3,000 ft. to 5,000 ft. above sea-level, at the foot of the Andes inland from the coast of Chile. In general character, the beds of nitrate-bearing material, although extensive in both Chile and Peru, are exceedingly patchy and vary greatly in thickness, the average being from 3 ft. to 4 ft. thick and at a depth of less than 2 ft. to 25 ft. or more below the surface. The nitrate ore, composed of a mixture of insoluble clayey or earthy matter, together with certain other soluble salts in addition to the nitrate of soda, bears the name of "caliche." The proportion of nitrate of soda in this may vary from under 10 to 50 per cent., the average approximating to 16 or 17 per cent.

After the caliche is roughly stripped or broken up in the deposit by blasting, it is sorted out and hauled in small trucks drawn by light locomotives to the refining-plants, a large number of which when in use operate what is termed the Shanks process. Here the nitrate is dissolved out with the aid of boiling water in tanks; the salts in solution are first of all separated from the insoluble matter, and then, by means of a chemically controlled system of selective crystallization conducted in large crystallizing tanks, the commercial salt is finally separated in a fairly pure state from the other saline substances in solution and dried. During the purification of the nitrate at the extraction works, valuable iodides and bromides are recovered as secondary products, and it is worthy of mention that a very large proportion of the world's supply of potassium iodide for use in mineral stock foods and licks and for medicinal purposes is taken from the Chilean nitrate. Another preparation of the industry is a concentrated nitrogenous-potassic fertilizer for market-gardens, &c., containing 15 per cent. of nitrogen and 14 to 16 per cent. of pure potash, bearing the trade name of Nitapo.

Most fertilizer users are probably aware that the standard nitrate sold contains a very small proportion of substances or impurities in addition to its actual content of nitrate of soda. The claim of 95 or 96 per cent. purity has no doubt been noticed in trade advertisements. In consequence of possessing 4 or 5 per cent. of these so-called impurities in the form of minor plant-food elements, such as iodine, magnesium, chlorine, &c., of no rated market value, additional to the nitrogen, it has been widely claimed that such accompanying elements have beneficial effect on plant growth. This may be true, but by one of the latest methods adopted for nitrate extraction in Chile—namely, the Guggenheim process, based primarily on a system of refrigeration and undoubtedly a great advance on the older and hitherto more general Shanks process—the so-called impurities are considerably reduced, if not almost entirely eliminated. This is indicated by the following more or less representative composition of the new-processed material: Nitrate of soda, 98·56 per cent. (equivalent approximately to 16·2 per cent. of nitrogen); magnesium chloride, 0·36 per cent.; sodium sulphate, 0·09 per cent.; sodium iodate, 0·07 per cent. (equivalent to 0·045 per cent. of iodine); moisture, 0·82 per cent.; and also traces of sodium carbonate and bi-carbonate, calcium sulphate, and potassium bromate. The older form guaranteed here to contain 15 per cent. of nitrogen—giving a calculated content of only 90 to 91 per cent.* of actual nitrate of soda—can be identified by its greyish or slightly discoloured yellow or pink coarsely crystalline appearance. The new material is in the form of small clear pellets.

From another angle, for the nutrition of crops such as mangels, the element sodium in combination with nitrogen as nitrate of soda has been found in field trials overseas to be of indirect value, just in

* With some the practice in the fertilizer trade is to guarantee (within the limits of error allowed by law) plant-food contents of fertilizers slightly lower than that which may be actually ascertained on analysis. With this class of nitrate the actual average nitrogen content lies nearer 15·5 per cent., equivalent to about 95 per cent. nitrate of soda.

the same way as elemental sulphur in sulphate of ammonia is of use for special soils and crops. There is, furthermore, a possibility that the availability of the potash compounds in some soils may be increased by the sodium when added in the combined state as nitrate of soda.

There does not appear to have been a great amount of nitrate employed in general farming in New Zealand. Supplies on the retail market are mainly purchased in small quantities and used in conjunction with phosphates and potash by market-gardeners, horticulturists, orchardists, and amateur gardeners, the latter most frequently applying the material as a liquid manure. It is noteworthy that thirty-four years ago nitrate of soda (15 per cent. nitrogen guarantee) was sold at Auckland for £15 10s. per ton or £1 0s. 8d. per unit, the same price asked for it to-day. The case of sulphate of ammonia is altogether different, for records in 1908 show that it was being sold in competition with the nitrate in the same city, with a guarantee of 18·9 per cent. of nitrogen, at £17 per ton (cash), or 17s. 11d. per unit, whereas now the product is much more favourably offered at £9 3s. per ton (cash), or 8s. 11d. per unit, for a 20·6 per cent. nitrogen grade. In comparing such unit or commercial values it is only fair to say that their agricultural or field values may give a different interpretation. The unit system of valuation, while of some use no doubt to both sellers and buyers, is not of much avail for measuring the crop-producing power of fertilizers, under widely divergent conditions of soil and climate, in terms of money. To this may be added the fact that any commercial or unit values based on current price-lists in a very short time frequently lose any significance they may appear to have, owing to price fluctuations.

Enormous quantities of refined nitrate have been exported from Chile to Europe and the United States in the past. It would be no exaggeration to say that practically every agricultural country has at some period during the past four or five decades imported the commodity, and to-day its production and agricultural consumption as a nitrogenous fertilizer salt is second only to that of sulphate of ammonia. Vast resources are estimated to be available for exploitation in Chile; authorities variously place the life of the deposits of the crude mineral at from two hundred to three hundred years at normal rates of production.

On more than one occasion of late the nitrate industry has faced a crisis; two years ago a reorganization scheme was embarked upon, and the industry was put under the control of a powerful combine embracing official (Chilean) and private interests principally of an international character, including British, with a capitalization of £75,000,000. The formation of this organization under the name of the Compañia de Salitre de Chile, or more briefly "Cosach," had for its objectives, *inter alia*, the reduction of costs of production and the centralization of manufacture in large efficient up-to-date (Guggenheim) plants. Further reorganization of this gigantic concern to meet existing and future conditions is reported to be again under consideration.

(Series to be continued.)

WOODLANDS FELICIE—WORLD RECORD JERSEY.

NEW ZEALAND COW'S PERFORMANCE UNDER C.O.R. TEST.

W. M. SINGLETON, Director of the Dairy Division, Wellington.

A NEW world butterfat record for the Jersey breed was created when at Waitara, Taranaki, on 17th August, 1932, Woodlands Felicie concluded her 365 days on Certificate-of-Record test with a total production of 17,332·6 lb. milk containing 1,220·89 lb. butterfat, average test 7·04 per cent. She was 4 years 364 days old at date of calving for start of test, 19th August, 1931, on which day her testing period commenced. Her previous calving date was 12th July, 1930. She is expected to calve subsequent to test on 3rd November, 1932, and, provided she calves not later than the 15th, will qualify for her first-class certificate and be eligible for classification as a C.O.R. cow. Her owner, Mr. P. J. Petersen, states that she has been in calf since 28th January, 1932, and so has carried a calf for 202 days of her 365-day testing period. She was milked three times daily throughout the entire period of test.

The highest previous authenticated yield for the Jersey breed was 1,197·51 lb. fat from 23,677 lb. milk, average test 5·06 per cent., this being the performance of the United States cow Abigail of Hillside on a record commenced at the age of 8 years 6 months. So far as our information goes, Abigail would not have qualified under the New Zealand C.O.R. rules relative to calving. Further, she was actually on test for thirteen months, and in computing her record the first month's production was discarded in favour of her yield for the thirteenth month, which was greater than that of the first thirty days. This procedure would not have been permitted in New Zealand, our rules providing that the test shall be for a maximum of 365 days commencing not later than the day after calving. Abigail's milk yield, however, remains considerably in excess of any other cow of the breed. In comparing the records of the two cows, the outstanding feature lies in the remarkable difference in average test, which was 5·06 for Abigail and 7·04 for Felicie, the average test for Jerseys throughout the world having remained practically constant for many years at approximately 5·5 per cent.

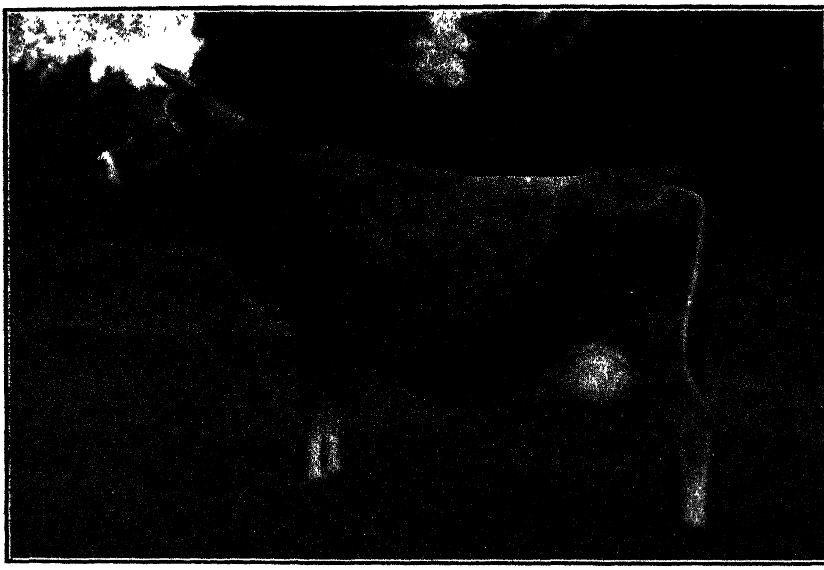
As butterfat champion of New Zealand for all breeds Woodlands Felicie displaces the Friesian cow Alcartra Clothilde Pietje, who during the 1921–22 season gained a C.O.R. for 1,145·24 lb. butterfat, on a test commenced at the age of 7 years 357 days.

Our records are not sufficiently complete to enable us to say with certainty where Woodlands Felicie stands among the leading butterfat producers of the British Empire, but cows which come to mind are the Australian Milking Shorthorn Melba XV of Darlbalara, whose phenomenal yield of 1,614·1 lb. butterfat places her far ahead of any other cow of any breed; De Kol Plus Segis Dixie, the Canadian Friesian, with 1,349·31 lb. butterfat; Agassiz Segis May Echo, Canadian Friesian, with 1,345 lb.; Bella Pontiac, another Canadian Friesian, with 1,270 lb.; Nellie Osborne of Elm Shade 16th,

Canadian Ayrshire, with 1,257·20 lb.; and Manor Keyes Bettina, Canadian Friesian, who in March, 1926, commenced test at 4 years 325 days old (the same age class as Woodlands Felicie) and produced 32,652 lb. milk containing 1,251 lb. butterfat, being milked four times daily.

Woodlands Felicie was bred by Mr. H. C. Sampson, of Hillsborough, Taranaki, and was first tested by Mr. Petersen as a junior two-year-old, when, commencing at 2 years 10 days of age, she gained a first-class C.O.R. for 8,265·6 lb. milk and 550·54 lb. butterfat in 365 days, with an average test of 6·66 per cent.

The sire of Woodlands Felicie is Bright Sultan, an imported bull bred by Messrs. B. H. Bull and Son, Ontario, Canada, and who,



WOODLANDS FELICIE. [" *Exporter* " *photo.*

on the sire's side, traces twice to Eminent, imported from Jersey Island and said to be one of the outstanding bulls of the breed. Bright Sultan has seventeen C.O.R. daughters. The dam of Woodlands Felicie is Woodlands Felicity, C.O.R. 671 lb. butterfat, who is by Mercedes Golden Laddie (eight C.O.R. daughters), who in turn is by Viola's Golden Laddie, champion butterfat bull with twenty-eight C.O.R. daughters, and imported from the well-known Linden Grove stud of the late Mr. T. S. Cooper, Pennsylvania. On what may be termed the New Zealand side of Woodlands Felicie's pedigree there are many noted animals, and scarcely a name which is not linked up with quality from a production point of view. Some of the more outstanding among the males are K.C.B. (though he was an imported bull), Stevenson, Pride of Egmont, and Jersey

Boy, and, among the females, Grannie, Mercedes Lady, Zephyr, and Zenith. Reviewed over a period of eight generations the pedigree of Woodlands Felicie shows little evidence of systematic breeding, its interest lying principally in the large number of breeders and strains represented.

The performance of Woodlands Felicie was very carefully supervised by the Dairy Division. Some fifteen testing visits were paid to the farm, and three different testing officers took part in checking the cow's yield. Particulars of her performance month by month are as follows:—

Month.	Days.	Milk.	Test.	Butterfat.
		lb.	Per cent.	lb.
August, 1931	13	414·7	7·03	29·15
September	30	1,573·5	6·19	97·39
October	31	1,714·2	5·84	100·10
November	30	1,652·8	6·67	110·24
December	31	1,602·1	6·69	107·18
January, 1932	31	1,579·6	7·11	112·30
February	29	1,403·1	7·14	100·18
March	31	1,355·3	7·18	97·31
April	30	1,342·8	7·31	98·15
May	31	1,440·7	7·66	110·35
June	30	1,235·1	8·11	100·16
July	31	1,323·0	7·87	104·12
August	17	695·7	7·80	54·26
Totals	365	17,332·6	7·04*	1,220·89

* Average.

We are not permitted to publish details of the food ration of Woodlands Felicie, but may say that strict attention was devoted to this phase of the supervision, and that in relation to her yield the cow received surprisingly little by way of special feed. She had, however, the advantage of excellent pasture and skilful handling, and is a cow of extremely placid disposition. At the close of her test Felicie was still yielding at the rate of over 40 lb. of milk per day, and she appears to show no sign of strain.

Detection of Abortion Disease in Dairy Herds.—Abortion in cows is caused by a germ. The afterbirth and discharge from an aborting cow spread the germs on the ground, from which they reach other cows through ingestion of the contaminated pasture. Animals affected with abortion disease can be diagnosed by the Wallaceville Veterinary Laboratory by means of a blood examination. All that the farmer has to do is to send blood in a ½ oz. bottle for testing. The blood should be collected from a cut in the end of the cow's tail. Abortion disease causes loss in the milk-supply, loss of calves, sterility in cows, and is also a source of danger to human beings. Therefore affected cows in a herd should be known. The blood-test is carried out by the Laboratory free of charge. The blood-test is known as the agglutination test. By its use affected cows in a herd can be segregated at calving time, thus preventing the spread of the disease. Departmental officers will advise any farmer interested in the methods of control of abortion disease, and farmers are well advised to avail themselves of this departmental service.

PASTURE TOP-DRESSING IN MARLBOROUGH.

EXPERIMENTAL WORK BY THE FIELDS DIVISION, PERIOD 1929 TO 1932.

R. McGillivray, Fields Superintendent, Christchurch, and A. G. Elliott, Instructor in Agriculture, Blenheim.

A large part of the Province of Marlborough consists of tussock grasslands occupied as sheep-runs. The total area of the province is 2,768,000 acres, of which the occupied area amounts to 2,482,754 acres. There are 1,925 holdings in the four counties into which the province is divided, and the average size of holding is 1,289 acres. An area of approximately 30,000 acres is in grain, pulse, root, and green crops, and of this area approximately 3,600 acres are in wheat. These figures clearly indicate the importance of the grassland farming carried on in the province. In certain districts dairy-farming is in operation, and where climatic conditions are favourable and pasture-improvement work has been undertaken this type of farming is successful, and there are now over 16,000 dairy cows within the boundaries of Marlborough Province.

Some Marlborough farmers have been top-dressing their pasture for a considerable number of years, but it is only of comparatively recent times that any forward move has been made, and even to-day there are only about 23,062 acres top-dressed. With the exception of the fertilizers applied to 3,000 acres, practically all the top-dressing has been done with superphosphate. Statistics show that under 1,000 acres have been limed. Experimental results show that an extension of liming is desirable, as in practically all experiments the combination of lime and superphosphate shows a much better response than superphosphate alone, and in grazing a preference is shown by stock for the pasturage on the lime-superphosphate plots.

In order to obtain some definite information in connection with manurial response in the various districts, thirty-two observational top-dressing experiments were laid down in the 1929 season, and in 1930 a further ten experiments of a slightly different layout were put down. In all these experiments lime, superphosphate, potash, and nitrogen were used, and this article presents the results obtained from the individual plots.

The responses-to-manure survey carried out per medium of this series of experiments has shown that any endeavour to permanently improve pastures by manurial treatment must be preceded by the sowing of improved strains of pasture plants if a full measure of success is to be obtained. This factor, fortunately, is now being attended to, and there is a good demand for certified seeds. The poor strains of pasture plants may in the early stages of development show satisfactory results from top-dressing, but in practically all cases their period of usefulness is short, while the good types are persistent in growth and highly productive.

The question of management and utilization of pastures has been taken up in connection with top-dressing operations, and the importance of management is now being generally acknowledged, but this cannot

be fully developed until a much larger area is sown with pasture mixtures containing elements of longevity and at the same time of high productive capacity.

The plots laid down were treated as follows :—

(1) Carbonate of lime ..	.. 1 ton per acre.
(2) Superphosphate ..	.. 3 cwt. per acre.
(3) 30 per cent. potash salts	.. 2 cwt. per acre.
(4) Sulphate of ammonia	.. 1 cwt. per acre at each application.

The initial dressings were applied during the winter of 1929. No further applications of lime were made, but superphosphate and 30 per cent. potash salts were each applied at the rate of 2 cwt. each season subsequent to the first, and there was a spring and autumn application of sulphate of ammonia at the rate of 1 cwt. per acre at each application.

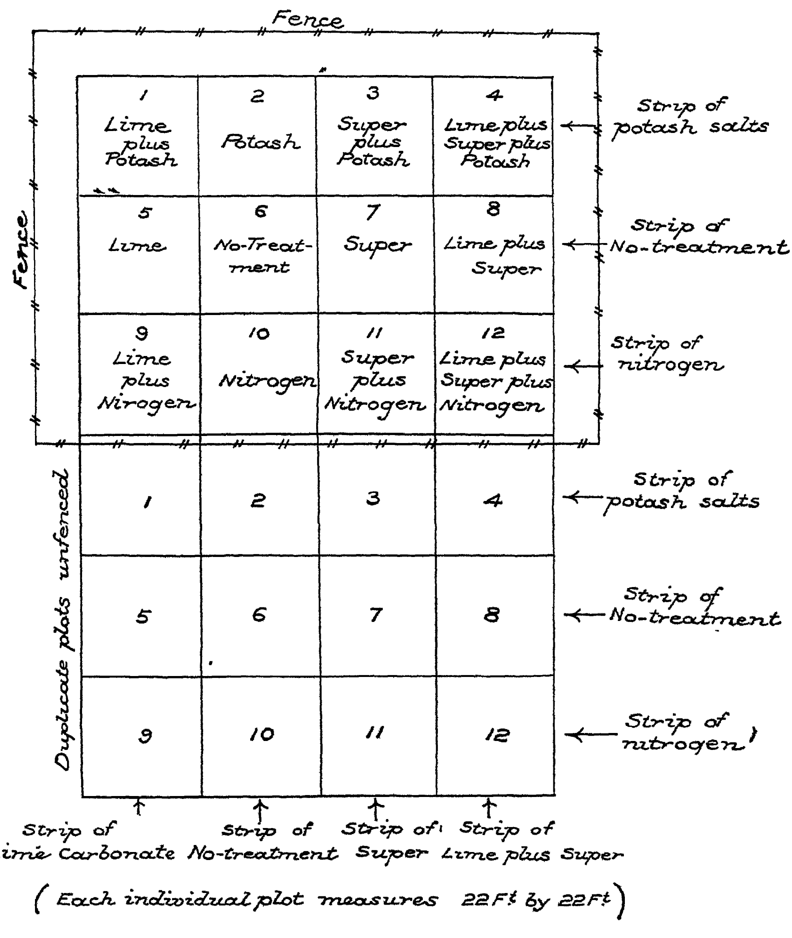


FIG. 1. PLAN OF STANDARD EXPERIMENT ADOPTED FOR THE SURVEY.

Distribution of Experiments and Management.

The co-operation of branches of the Farmers' Union was invited in the selection of areas on which plots were established, and the scheme for laying down those in 1929 was the same as that adopted in Canterbury (see this *Journal* for October, 1930, page 249, and November, 1930, page 326), as shown in Fig. 1. This provided for the intensive grazing and spelling of half the area, which was fenced off, while the remaining duplicate plots received the same treatment as did the rest of the paddock. It soon became evident, however, that, in the dairying districts at least, it was practically impossible to make full use of the flush of feed in the fenced portion, so that during the next year the whole area top-dressed was grazed with the remainder of the field.

In 1930, plots to the number of ten were laid down under a modified plan in the Seddon, Ward, and Kaikoura districts, thus completing the chain. The position of each experiment is indicated on the map by a dot, and the numbers correspond to those used in Table 2.

Interpretation of Results as recorded in Tables 1 and 2.

In order to indicate as briefly as possible the nature of the effect of lime or manures applied, the following points are awarded: 0 = no visible response; ? = doubtful response; 1 = slight response; 2 = fair response; 3 = good response; 4 = very good response; 5 = excellent response.

In some cases responses to both lime and super individually may be classed as "good" (3 points each), and the response to the combined lime plus super as "very good" or "excellent" (4 or 5 points). In such cases the combined effect of lime plus super may be regarded as practically equal to the sum of the effects of the individual treatments. Points awarded to potash and nitrogen may be regarded as representing their response in conjunction with super or lime plus super.

In Table 1 the responses coming in the various classes mentioned above are presented as percentages of the total number of trials. In Table 2 the responses in the individual trials are shown grouped in districts.

Table 1.—Percentages of Total Number of Experiments which fall in various Response Classes so far as Response to main Treatments is concerned.

Treatment.	Degree of Response to Treatment.							Total Number of Experiments in which Treatment used.
	None Visible (0).	Doubtful (?).	Slight (1).	Fair (2).	Good (3).	Very Good (4).	Excellent (5).	
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
Lime	..	4·8	36·0	31·2	24·0	2·4	..	42
Super	..	..	4·8	33·6	43·2	19·2	..	42
Lime plus super	..	..	..	4·8	36·0	43·2	16·8	42
Potash ..	93·6	7·2	..	..	..	..	..	42
Nitrogen ..	..	..	2·4	48·0	48·0	2·4	..	42

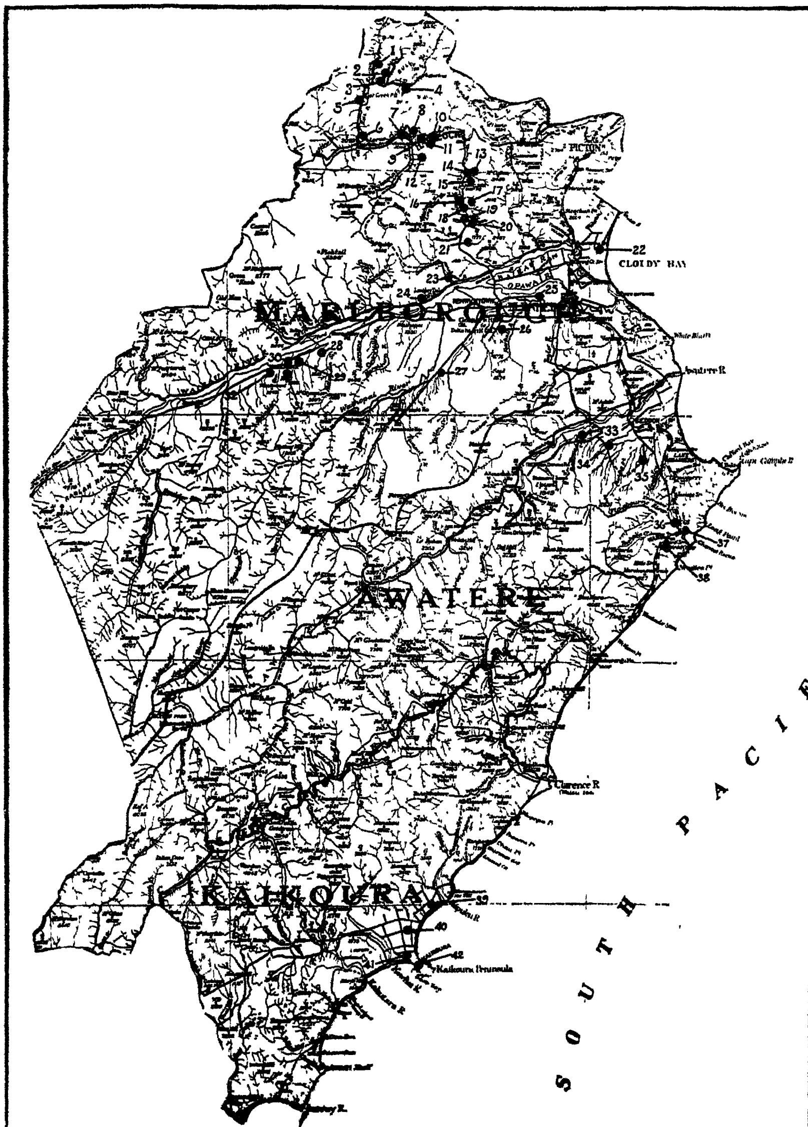


FIG. 2. MAP SHOWING LOCATION OF THE TOP-DRESSING EXPERIMENTS IN MARLBOROUGH PROVINCE (see Table 2).

GENERAL COMMENTS ON RESPONSES TO TREATMENTS: TABLE 1.

Lime.—About 95 per cent. of the trials gave "slight" to "very good" responses to lime alone, the majority of these, 36 per cent. and 31 per cent., being in the "slight" and "fair" response classes respectively. In the heavier rainfall districts, through the Okaramio

and Mahakipawa Valleys, and also to some extent on the heavy cropping land around Tuamarina, liming has been a regular practice for some years, but the use of this soil-improver is by no means general. At one time, too, there was a distinct prejudice against Flaxbourne lime, which was supposed to be insufficiently ground, but results secured on the small plots have largely dissipated this impression.

The duration of the effect from applications of lime is likely to be influenced by rainfall. Since lime washes out of the soil to some extent, it is unlikely that the effect of a single dressing of, say, 1 ton per acre will last as long as in the Rai Valley (90 in. rainfall) or at Kaikoura (50 in.) as it will at Seddon (25 in. rainfall). Following an initial heavy application, small applications of, say, 4 cwt. to 5 cwt. every year or two should be well worth while under the high rainfall conditions. Since farmers have been able to see the effect of lime, particularly when associated with superphosphate, there has been an appreciable increase in the quantity used on pastures and clover stands saved for seed. The northern districts secured their requirements from Stoke and Wakapuaka by lorries back-loading after delivering timber to Nelson, and thus those settlers purchased lime at a fairly cheap rate. The Flaxbourne Limeworks supply the middle districts, while the Kaikoura farmers secure their consignments from Greenhills or North Canterbury.

Superphosphate.—Reference to Table 1 shows that 40 per cent. of plots showed a "good" response and over 19 per cent. a "very good" response to applications of this fertilizer, which is obviously the most economical one for all the needs of the territory.

Lime plus Superphosphate.—In 79 per cent. of the trials responses from "good" to "very good" were recorded from this combination and over 16 per cent. were in the "excellent" class. This needs no comment other than to emphasize the improvement in clover content, and thus the production of a much more valuable pasture, particularly in the heavier rainfall districts. These plots have been of particular interest to observers, as they have demonstrated the fact that results from super can be made much more profitable where lime is added, even at its present rather high price. It can generally be accepted that lime at 1 ton per acre will benefit the soil for a considerable number of years, so that the cost, spread over a long period with marked benefit to the pastures, is an outlay that is proving payable to farmers.

Potash.—In all except three experiments, where doubtful responses were recorded, the application of potash had no visible effect, and the plots top-dressed were neglected by stock to the same extent as where no manure was applied. Even on clover stands saved for seed the use of this fertilizer made no appreciable difference, so it appears evident that potash is not markedly deficient in the local soils.

Nitrogen.—In over 90 per cent. of cases responses to nitrogen fell into the "fair" and "good" classes. The best results were secured where nitrogen plots crossed those top-dressed with lime plus super or super alone. Plots treated with nitrogen alone soon developed a very open sward in which volunteer grasses and weeds became established, and in the majority of cases the effect of the fertilizer lasted only from six to eight weeks. From this evidence it is obvious

Table 2.—Showing Responses to Lime and Manures on Individual Farms.

Reference Number on Map.	Farmer's Name and Address.	Treatments.				
		Lime.	Super.	Lime plus Super.	Potash.	Nitrogen.
	Rai Valley District.					
1	D. Young, Ronga	2	3	4	0	3
2	G. W. Wratt, Tunakina ..	2	3	4	0	3
3	W. Wilson, Carluke.. ..	2	3	4	0	3
4	G. Wells, Opouri	2	2	3	0	2
5	E. G. Hill, Rai Valley ..	1	3	3	0	3
6	B. T. Francis, Rai Falls ..	?	2	2	0	2
	Canvastown District.					
7	N. J. Ward	2	3	4	0	3
8	J. Rutland	1	3	4	0	2
9	B. Anderson	2	4	5	0	3
10	J. Elliott	1	2	3	0	2
11	C. F. Hart..	?	1	2	0	2
12	R. J. Diamanti, Wakamarina	2	2	3	?	2
	Havelock Suburban District.					
13	J. W. Price	2	4	4	0	3
14	O'H. Newman	3	3	4	0	2
15	R. F. Crispin	1	2	3	0	2
16	J. W. McDowell	2	3	4	?	3
17	D. Higgins	2	2	3	0	2
	Okaramio District.					
18	W. Kennington	1	2	5	0	2
19	J. Kennington	1	2	5	0	1
20	C. Nees	2	3	4	0	3
21	A. Leslie	3	4	5	0	3
	Blenheim District.					
22	E. Smith, Tuamarina ..	3	3	4	0	3
23	C. E. Peake, Onamalutu ..	3	3	4	0	2
24	A. M. W. Adams, Langley Dale	3	4	5	0	4
25	H. S. Reeves, Rapaura ..	3	3	4	?	3
26	J. W. Paynter, Fairhall ..	2	2	3	0	3
27	F. N. Dillon, Leefield ..	1	3	4	0	3
	Hillersden District.					
28	J. R. Gifford	2	3	4	0	3
29	A. Bishell	3	4	5	0	2
30	T. Mappe	1	1	3	0	3
31	T. Mappe	1	3	4	0	3
32	J. C. Martin	2	3	4	0	3
	Seddon District.					
33	S. Richmond, Richmond Brook	1	2	3	0	2
34	G. A. Gunn, Richmond Brook	1	2	3	0	3
35	J. F. Neal, Tetley Brook ..	1	3	3	0	2
	Ward District.					
36	W. G. McNabb	1	2	3	0	2
37	W. H. Butt	1	2	3	0	2
38	W. J. McIsaac	1	2	3	0	2
	Kaikoura District.					
39	Hailes Bros., Kincaid ..	5	4	5	0	3
40	T. Stack	3	4	5	0	3
41	F. Monk	3	4	5	0	3
42	Ludstone Estate	2	3	4	0	2

that, so far as this territory generally is concerned, pastures are still so deficient in lime and phosphate that a profitable return cannot be expected from nitrogen, which is not only costly but has such a short period of usefulness. Its use is justified only on pastures having a good grass-sward, principally of good perennial rye-grass, and then possibly only for the production of early spring feed or for seed production when used in conjunction with super or lime plus super.

COMMENTS ON TABLE 2.

Rai Valley District.—Outstanding results were secured from the use of lime plus super, and nitrogen was " good " where crossed by this combination. Pastures are on partly stumped and surface-sown bush-land, or on areas which have been completely stumped and ploughed. All plots are on loamy soils, with an average annual rainfall for the district of over 90 in. Experiment 6 was on a very poor pasture on sandy loam soil, while Experiment 5 was established in an area saved for clover seed. Plots were not harvested separately in any of these, but results were judged from general appearance and a count of seed-heads.

Canvastown District.—Experiments 7, 8, 9, and 10 were on good-quality loams, and pastures responded well to treatment, but in the other two cases, on fairly steep hill paddocks, responses on inferior swards were not marked. Lime plus super gave the best results, while the response from nitrogen was very fair in some cases. The annual rainfall of the district is approximately 50 in.

Havelock Suburban District.—Lime plus super gave outstanding results, but lime alone and super alone also gave fair to good responses. Experiment 17 was on fairly steep hill country, while the others were located on the old alluvial valley of good loamy soil. The annual rainfall for the district, which is one of the principal sources of red clover seed, is 53 in.

Okaramio District.—All experiments were laid down on good-quality loam soils and on very fair pastures. Experiment 18 was in a red clover stand, and lime plus super was outstanding in this as well as in the other three areas. For seed-production growers in this district follow the practice of autumn liming up to 1 ton per acre, and follow this with super. From results recorded in these experiments the value of the practice for ordinary pastures has been fully demonstrated, and it is being followed. The average annual rainfall for the district is approximately 50 in.

Blenheim District.—The six experiments were established in various localities on the Wairau Plains, and, as many soil-types and sets of climatic conditions were covered, each plot had better be commented on in detail.

Experiment 22 was established on good silty loam and on a good pasture, which in the second year was badly infested by grass-grub. There was marked response from lime and lime plus super, which was not so obvious in the third year, when volunteer growth replaced much of the original sward. The soil retains moisture and received benefit of seepage from the Wairau. Rainfall average is 27 in. per annum.

Experiment 23: Plots were laid down on what was later used as a hay paddock, with the result that differences were really observed

at one period of the season only. The whole field was sheltered, and utilization of feed was not always complete. The soil is a heavy silt and loam, and rainfall approximately 40 in.

Experiment 24: Situated in a roadside field on good pasture where management was very good and differences marked. Lime plus super gave outstanding results, closely followed by super and nitrogen. Strips of this last fertilizer remained a fresh green colour throughout the year. Differences were marked by closer grazing, and in the case of lime plus super by a definite thickening up of the sward due to increased clover growth. Annual rainfall approximately 40 in.

Experiment 25: Established on a pasture now running out, due to lack of moisture consequent on the diversion of the Opawa River. Best results were secured from the lime plus super plots, where reversion to inferior grasses was checked and some clover growth stimulated, but payable increases will depend on moisture-supply. Response from potash was doubtful. Annual rainfall approximately 25 in., and soil a light silt.

Experiment 26: Lime plus super gave best results, but, as in the last experiment, insufficient rainfall and soil-moisture limited full benefit from the fertilizers. The soil is a sandy loam, and annual rainfall as in Experiment 25.

Experiment 27: Established on rolling downs where soil is inclined to be stiff. Lime plus super gave the best results, and these plots were closely grazed. Super also gave a payable increase, but low rainfall precludes securing high returns from fertilizers. Annual precipitation approximately 25 in.

Hillersden District.—These experiments were established on silty to loam soils where the life of pasture is generally from three to five years without top-dressing. Lime plus super gave outstanding results, particularly in Experiment 29, where marked differences were observed until the plot was discontinued owing to the abandoning of the farm by the owner. On Experiments 28 and 32 lime plus super and super have checked reversion, and a close sward of rye-grass, crested dogstail, and clovers is being established. Average rainfall 27 in.

Seddon District.—Two very dry seasons have followed the establishment of the plots, and differences have not been marked. Lime plus super and super in all three experiments had some effect, but increases under the conditions of rainfall experienced are considered not payable. The soil is a sandy loam, and annual rainfall 25 in. Pasture ran out in Experiments 33 and 34, following severe grass-grub attack, and the areas were put into crop

Ward District.—Conditions were similar to those in the Seddon territory, and although lime plus super and super gave the best results they could not be regarded as payable. Soils mainly light loams and silty soils. Annual rainfall 23 in.

Kaikoura District.—Lime plus super gave outstanding results in all except Experiment 42, which was on good loamy soil and was later abandoned due to change of ownership and inability to keep the plots well grazed. Even on this experiment the response to lime and super was very good, however. Lime gave marked results in Experiment 39, and with super undoubtedly gave a payable increase. A splendid demonstration in top-dressing was supplied by Experiment 41, where very marked results were secured, and the establishment

of this area has undoubtedly greatly influenced local top-dressing practice. Annual rainfall 45 in.

SUMMARY.

During 1929 and 1930 forty-two observational experiments on top-dressing of pasture were laid down in Marlborough Province with the object of determining what observable response would result from the application of carbonate of lime, superphosphate, 30-per-cent. potash salts, and nitrogen in the form of sulphate of ammonia.

(1) The outstanding features of the trial were: (*a*) A general response from lime and super, especially where these treatments were combined; (*b*) a comparative absence of observable effects from the use of potash; (*c*) a general response from the use of sulphate of ammonia.

(2) The need for greater use of better and more persistent strains of certified pasture plants, and better utilization of growth, if full benefits from the use of lime and fertilizers are to be obtained, has been stressed.

(3) With the possible exception of the drier districts represented by Ward and Seddon, the use of lime and superphosphate in conjunction with one another must be regarded as a paying proposition on reasonably good pastures.

(4) So far as can be judged by observation the use of potash is not warranted.

(5) The general use of nitrogen cannot be regarded as being worth while, except where early spring or late autumn feed is particularly desired (and then only on pastures which are reasonably good in the better grasses) or for the production of grass-seed crops. It is viewed as essential that its use should be accompanied by that of lime and superphosphate.

The writers wish to acknowledge the assistance given by farmers in placing fields at the disposal of the Department for the purpose of the trials herein reported upon. Thanks are also due to the various Farmers' Union branches and agricultural and pastoral societies for their general assistance and co-operation in connection with the carrying out of arrangements for experimental areas in the various districts.

LIMONITE FOR CONTROL OF BUSH SICKNESS.

FARMERS' EXPERIENCES IN AFFECTED DISTRICT.

AN interesting report from Mr. H. R. Pearson, honorary secretary of the Tokoroa Progress League, was received recently, with a suggestion that it might be published in the *Journal*. The report embodies the local farmers' own opinion of the use of limonite in the farming of a large area of land which is only slightly bush-sick, and constitutes a good record of experience with this recently introduced remedy. After some remarks on the properties of limonite and its advantages, Mr. Pearson states:—

Limonite was introduced into the Tokoroa district in January of this year, and during the last six months the Tokoroa Progress League has kept in touch with settlers who are using the lick. In several cases accurate

records were kept, and the League is able to report a number of instances where splendid results have been obtained.

One of the most interesting cases that came under the notice of the league was that of a herd of cows owned by Mr. M. S. Mathiasen, of Tokoroa. Mr. Mathiasen's herd was not in the best of condition, and several cows were showing signs of sickness. The peak of production was reached in December, and in the first period of January a considerable falling-off was shown. The limonite lick was given to the herd about the middle of January, and the milk production rose continuously right through January and February. For the first period in March the production was higher than for the corresponding period in January, but by that time the autumn conditions were making themselves felt and production began to fall. The butterfat statements from the factory were shown to the writer, and the figures are as follows: December, 1,011 lb.; January, 956 lb.; February, 1,075 lb.; March, 984 lb. It will be noticed that the total production for March is very little behind that of December, the peak month before the use of limonite.

In the 1930–31 season Mr. Mathiasen reared twenty-four calves, which did very well till they were weaned. Then they began to waste away and all had died before the spring of 1931. This past season only twelve calves were reared, and in January they began to show the usual signs of sickness. They were given the lick towards the end of that month, and showed an immediate improvement. Now, at the end of May, the twelve calves are in fine condition, and will make a valuable addition to the herd in years to come.

Another Tokoroa settler, Mr. R. D. Thomson, had one very sick cow in his herd, and decided to drench this cow with limonite, and check up definitely on the improvement in milk yield. The cow was milked by hand in the evenings, and at the beginning of the test gave 3 lb. of milk at the evening milking. The cow was drenched daily, the dose being half-a-tablespoonful of limonite in a pint of water. On the evening of the tenth day the milk yield had risen to 10 lb., and the cow was in much better health. All the cows had access to the usual limonite lick, and Mr. Thomson reports a decided improvement in the health of the herd since the lick was first made available to them.

Mr. L. A. Newell also gives interesting testimony to the value of limonite, and as his herd is under test the figures can be taken as accurate. Up to January, Mr. Newell's herd averaged 4 lb. of butterfat per cow less than for the same period of the previous year. Since January the cows have been given limonite, and have milked so well as to bring the average for the year up to within 1·37 lb. of butterfat per cow of the previous year's figure. It is obvious that the cows have milked wonderfully well during the autumn, and Mr. Newell is confident that limonite was responsible for this very satisfactory result.

The writer has before him a letter from Mr. Newell, and one paragraph is of particular interest. He says, "I have twenty Jersey cross heifers doing very well. The last three years I have lost most of my calves, but this year, on limonite, they are showing no signs of sickness."

Mr. Campbell reports the case of a young bull that was turned out on a distant part of the property. The bull became sick and was so feeble that he got down and was lying in the paddock for several days before he was found by a shepherd. He was then urged to his feet, and was driven with great difficulty to the homestead, where he was put in a paddock where limonite was available. Three weeks later the bull was fit and well.

Another settler had a similar experience with a lamb that found its way to the back of the farm where no lick was available. The lamb became so sick that it had to be carried back to the house. It was given the lick, which it took greedily, and a few weeks later it had completely recovered and was in fine condition.

THE OFFICIAL SEED-TESTING STATION.

RECORD OF OPERATIONS FOR YEAR 1931.

N. R. Foy, Seed Analyst, Plant Research Station, Palmerston North.

For the calendar year 1931 11,766 seed-samples were tested at the Department of Agriculture's Seed-testing Station at Palmerston North, this representing an increase of 1,305 samples on the number received during the previous year.

Table 1.—Origin of Samples received, 1931 and 1930.

Senders, &c.	Number of Samples. 1931.	1930.
Seed-merchants	9,236	8,856
Farmers and seed-growers	238	190
Government Departments (other than Agriculture) ..	224	130
Massey Agricultural College	..	247
Agriculture Department—		
Fields Division	262	141
Plant Research Station	824	642
Retests	96	255
Ultra-violet light tests	886	..
Totals	11,766	10,461

Table 2.—Number of Samples received each Month, 1931 and 1930.

Month.	Number. 1931.	1930.	Month.	Number. 1931.	1930.
January	702	578	July	1,303	932
February	652	773	August	1,208	1,119
March	1,086	1,251	September	1,260	1,181
April	805	807	October	896	847
May	1,030	1,276	November	753	483
June	1,256	831	December	815	303

Table 3.—Classification and Numbers of Samples and Tests, 1931 and 1930.

Classification.	Number. 1931.	1930.
Samples for purity and germination	4,377	3,889
Samples for purity only	197	133
Samples for germination only	6,292	6,439
Purity tests made	4,574	4,022
Germination tests made	10,669	10,328
Ultra-violet light tests	886	..
Total tests made	16,129	14,350

The accompanying tables, 1, 2, 3, 4, and 5, show the distribution, origin, classification, &c., of the various samples. Of the samples shown for the Plant Research Station, about one-half represent Seed-testing Station tests, and the remainder samples received from the Mycologist, Agrostologist, Agronomist, &c., in connection with their various activities.

Table 4.—Number of Samples from Land Districts and Centres therein, 1931 and 1930.

Land District, &c.	1931.	1930.	Land District, &c.	1931.	1930.
Southland (total) ..	2,712	2,721	Otago (total) ..	898	924
Gore	1,592	1,392	Dunedin ..	810	860
Invercargill ..	1,094	1,326	Other	88	64
Other	26	3	Hawke's Bay ..	613	700
Wellington (total)	2,078	1,671	Taranaki ..	402	416
City	842	649	Marlborough ..	228	184
Palmerston North and Feilding	1,027	790	Gisborne ..	101	24
Other	209	232	Nelson	4	..
Canterbury (total) ..	1,264	1,117	North Auckland ..	1	..
Christchurch ..	722	581	Overseas	28	57
Other	542	536			
Auckland (total) ..	930	1,042			
City	848	934			
Other	82	108			

Table 5.—Number of Samples of Various Seed Species reported on in 1931 and 1930, and Number of Tests made thereon in 1931 (excluding Special Station Tests).

Species.	1931.			1930.
	Purity Tests.	Germination Tests.	Samples.	Samples.
Grasses.				
Perennial rye-grass (*Lolium perenne*) ..	686	2,385	2,394	2,272
Italian rye-grass (*Lolium multiflorum*) ..	81	247	249	324
Western Wolths rye-grass (*Lolium westwoldicum*)	24	150	150	184
Cocksfoot (*Dactylis glomerata*) ..	197	402	411	442
Crested dogstail (*Cynosurus cristatus*) ..	572	779	802	897
Chewings fescue (*Festuca rubra* var. *fallax*)	765	888	906	1,035
Brown-top (*Agrostis tenuis*)	464	449	464	852
Danthonia pilosa	8	27	27	45
Timothy (*Phleum pratense*)	43	80	81	97
Fog (*Holcus lanatus*)	48	49	53	38
Meadow-fescue (*Festuca pratensis*) ..	7	23	23	15
Meadow-foxtail (*Alopecurus pratensis*) ..	33	33	33	40
Paspalum (*Paspalum dilatatum*) ..	8	57	57	87
Poa pratensis	16	29	30	37
Poa trivialis	6	9	9	17
Prairie-grass (*Bromus unioloides*) ..	5	27	27	27
Red-top (*Agrostis palustris*)	2	2	2	9
Yarrow (*Achillea millefolium*)* ..	14	20	20	17
Other grasses, &c.	10	11	12	24
Totals	2,989	5,667	5,750	6,459

* Included here for convenience.

Table 5—continued.

Species.	1931. Purity Tests.	1931. Germination Tests.	1931. Samples.	1930. Samples.
Clovers, &c.				
White clover (*Trifolium repens*) ..	490	590	632	523
Red clover (*Trifolium pratense*) ..	194	408	419	412
Alsike (*Trifolium hybridum*)	40	79	82	69
Alsike and white clover (mixed) ..	16	32	32	32
Subterranean clover (*Trifolium subterraneum*)	12	44	44	37
Strawberry clover (*Trifolium fragiferum*)	4	6	6	5
Crimson clover (*Trifolium incarnatum*)	1	8	8	19
Suckling clover (*Trifolium dubium*) ..	12	18	19	28
Lucerne (*Medicago sativa*)	13	66	67	50
Trefoil (*Medicago lupulina*)	4	21	21	21
Lotus major	23	35	36	48
Lotus hispidus	5	10	10	17
Other clovers, &c.	10	16	16	31
Totals	824	1,333	1,392	1,292
Roots and Cruciferous Forages.				
Swede (*Brassica campestris*)	..	245	245	231
Turnip (*Brassica rapa*)	1	370	370	337
Rape (*Brassica napus*)	1	103	103	116
Kale (*Brassica acephala*)	1	92	92	82
Mustard (*Brassica arvensis*)	..	21	21	19
Mangel (*Beta vulgaris*)	1	172	172	182
Carrot (*Daucus carota*)	..	68	68	79
Totals	4	1,071	1,071	1,046
Cereals, Vegetables, &c.				
Oats (*Avena sativa*)..	..	59	59	65
Wheat (*Triticum vulgare*)	..	29	29	24
Barley (*Hordeum vulgare*)	..	24	24	20
Rye-corn (*Secale cereale*)	..	9	9	7
Vetches (*Vicia* spp.)	..	4	4	2
Peas (*Pisum sativum*)	2	251	251	220
Japanese millet (*Echinochloa frumentacea*)	..	17	17	18
Other forages	..	13	13	13
Vegetable seeds (other than peas) ..	..	368	368	369
Flower-seeds	..	32	32	43
Forest-tree seeds	..	5	5	2
Seed mixtures	30	131	34	42
Totals	32	942	845	832

GRASS-SEEDS.

Tables 6, 7, and 8 present various data in relation to the purity and germination of the principal species of grass-seeds.

Rye-grass.—The average germination percentage of all samples of perennial rye-grass showed an improvement over that for the previous

year, 33 per cent. of the samples germinating over 90 per cent., compared with 7 per cent. for 1930. Seed from Hawke's Bay, Poverty Bay, Sandon, and Canterbury districts was much superior than for three years past, just on 90 per cent. of the samples in all four groups showing over 90 per cent. germination. With the exception of the seed grown in Southland and parts of Otago, certified lines were all of a high purity and germination.

The low germination capacity of the Southern seed has been shown to be due to an abnormal seed condition, the incidence of which is associated with high atmospheric humidity. (See *Journal*, May, 1932, page 316.) The unusually low average germination obtained for Hawke's Bay and Poverty Bay seed during the previous three seasons (1928, 1929, and 1930) has been ascribed to the same cause, and it can be stated that the success of the production of perennial rye-grass seed in New Zealand is, from the point of view of germination capacity, dependent upon the climatic conditions of the district of production, and that only in districts with hot dry summer climates can high-quality seed be produced with any degree of certainty.

Awned seeds of Italian rye-grass occurred in 70 per cent. of all samples marked perennial rye-grass—in 83 per cent. of Southern, 60 per cent. of Canterbury, 48 per cent. of Sandon, 38 per cent. of Hawke's Bay, 50 per cent. of Poverty Bay, and 16 per cent. of certified samples.

Untabulated Grass-seeds.—The average percentage germination of the grass-seeds not included in the tables are as follows: Meadow-fescue, 80; Poa trivialis, 67; ratstail, 50; red-top, 97; tall fescue, 86; prairie-grass, 87; Agrostis maritima, 97; Phalaris bulbosa, 17; yarrow, 79.

Table 6.—Average Percentage of Seed Impurities and Germination of the Main Species of Grass-seeds (all samples), 1931.

Species.	Average Percentage of Seed Impurities.		Percentage of Germination.				Percentage of Samples Germinating in Groups.				
	Crop.	Weeds	Average. 1931.	Average. 1930.	Maximum.	Minimum.	Below 60.	60–69.	70–79.	80–89.	90–100.
Perennial rye-grass ..	0·8	0·6	80	70	99	6	10	9	21	27	33
Italian rye-grass ..	0·1	0·4	88	75	99	15	5	4	11	21	59
Western Wolths ..	0·1	0·3	90	73	99	42	7	6	3	8	76
Cocksfoot	4·3	0·3	75	68	97	Nil	10	18	28	32	12
Crested dogstail ..	1·8	0·3	87	88	99	39	2	5	12	32	49
Chewings fescue ..	0·8	0·2	91	81	99	2	3	2	3	12	80
Brown-top	0·1	0·6	94	95	99	25	1	2	1	5	91
Timothy	0·2	0·1	87	89	99	1	11	1	..	4	84
Fog	7·7	2·1	92	90	98	74	..	..	2	13	85
Poa pratensis ..	0·1	0·4	65	61	91	13	28	28	28	10	6
							0–29	30–39	40–40	50–59	60–100
Meadow foxtail ..	4·0	2·1	50	46	91	1	17	16	10	6	51
Danthonia spp. ..	8·7	9·9	41	49	85	Nil	33	17	16	22	22
Paspalum	0·1	0·3	46	23	66	2	28	12	21	32	7

Table 7.—Average Percentage of Germination and Seed Impurities of the Main Grass-seeds grouped according to Origin, 1931 and 1930.

Samples.	Average Percentage of Seed Impurities.	Percentage of Samples germinating in Groups. Below 70.		70–79.		80–89.		90–100.		Average Percentage of Germination.		Number of Samples.	
		1931	1930	1931	1930	1931	1930	1931	1930	1931	1930	1931	1930
Perennial Ryegrass.													
All samples	1·4	19	40	21	32	27	21	33	7	80	70	2,083	2,136
Southern	1·1	27	40	30	36	35	19	8	3	74	72	1,204	996
Canterbury	1·5	9	25	9	22	20	33	62	20	89	78	241	197
Sandon	0·8	14	82	13	9	21	1	52	8	87	48	75	86
Hawke's Bay	3·3	1	46	3	28	12	21	84	5	93	67	351	543
Poverty Bay	1·2	8	70	9	16	14	7	69	7	88	59	64	82
All certified	2·9	7	45	1	33	3	16	89	6	91	68	302	119
North Island certified ..	3·3	..	45	..	33	4	16	96	6	96	68	257	119
Canterbury certified .	0·8	..	..	..	..	..	..	100	..	95	..	22	..
Southland certified ..	0·9	96	..	4	..	..	..	..	..	27	..	23	..
Cocksfoot.													
All samples	4·6	28	45	28	36	32	15	12	4	75	68	396	434
Imported	0·7	70	44	7	36	13	20	10	..	57	68	31	52
Akaroa	3·3	17	51	36	36	32	10	15	3	77	70	75	86
Plains	5·1	25	46	32	25	35	20	8	9	77	71	142	107
Crested Dogstail.													
All samples	2·1	7	6	12	7	32	25	49	62	87	88	768	871
Chewings Fescue.													
Southern (all samples) ..	1·0	5	12	3	13	12	45	80	30	91	81	827	1,003
Brown-top.													
All samples	0·7	3	1	1	2	5	5	91	92	94	95	450	750
Certified*	0·7	3	..	..	..	1	3	96	97	94	97	80	83

* Southern and Canterbury.

Table 8.—Average Percentages of Pure Seed, Germination, &c., of Samples tested according to International Rules.

Seeds.	Purity. Pure Seed.	Other Crop Seed.	Weed Seed.	Inert Matter.	Percentage of Germination of Pure Seed.	Percentage of pure germinating Seed.
Certified perennial rye-grass—						
All samples ..	96·3	1·2	1·7	0·8	91·0	87·6
North Island ..	95·9	1·5	1·8	0·8	96·3	91·1
Canterbury ..	97·8	0·2	0·6	1·4	95·2	93·1
Southern ..	97·8	0·4	0·5	1·2	27·4	26·9
Brown-top—						
All samples ..	97·6	0·1	0·6	1·7	94·3	92·1
Certified seed ..	98·5	0·1	0·6	0·8	94·4	93·3
White Clover—						
Certified seed ..	94·4	3·8	0·7	1·1	83·4	78·5
Red clover	99·4	0·1	0·2	0·3	96·0	95·4
Cocksfoot	84·0	1·7	0·2	14·0	82·0	68·0
Chewings fescue ..	97·8	0·4	0·2	1·6	92·4	87·9
Crested dogstail ..	99·2	0·5	0·3	0·2	88·4	87·8
Meadow-foxtail ..	61·4	4·0	2·1	29·4	50·3	32·5
Yorkshire fog ..	84·3	8·4	3·3	2·8	93·2	77·8
Agrostis maritima	97·4	0·1	0·2	2·3	97·0	94·4

Clovers and Related Species.

The average percentages for the main clovers and related species are shown in the following table :—

Table 9.—Average Percentage of Seed Impurities and Germination of the Main Clovers and of Related Species according to Origin.

Seed.	Average Percentage of Seed Impurities.		Average Percentage of Germination.		Percentage of Samples germinating in Groups.			Average Percentage of Hard Seeds.
	Crop.	Weed.	1931.	1930.	Below 80.	80–89.	90–100.	
White clover—								
All samples ..	4·5	1·1	84	83	21	34	45	10·5
Certified	3·8	0·7	83	83	32	28	40	14·6
New Zealand uncertified	4·6	1·1	86	83	47	34	19	10·6
Imported	0·6	1·1	85	78	12	63	25	1·2
Red clover—								
All samples ..	0·1	0·4	88	87	11	27	62	5·2
New Zealand ..	0·1	0·3	89	89	11	27	62	5·2
Imported	0·1	0·1	75	76	25	25	50	3·9
Alsike	2·1	0·2	81	86	36	34	30	5·9
Subterranean clover ..	0·1	..	82	76	50	43	7	16·0
Strawberry clover ..	8·4	0·2	81	82	34	33	33	14·0
Crimson clover ..	0·1	..	70	77	26	12	62	0·5
Suckling clover ..	16·7	8·5	71	51	72	22	6	19·3
Lucerne	0·7	0·2	74	82	60	23	17	13·5
Trefoil	0·1	0·1	79	86	40	30	30	2·0
Lotus major	11·2	0·9	76	65	63	23	14	11·4
Lotus hispidus ..	40·6	0·3	60	47	100	..	..	21·5

The average germination percentages of other clover seeds, &c., not included in Table 9, are as follows: Lotus corniculatus, 59; Bokhara clover, 18; sweet clover, 62; alsike and white clover (mixed), 76.

Roots and Cruciferous Forages.

The average germination percentages of these seeds are as follows :—

Table 10.—Average Germination Percentages of Roots and Cruciferous Forages.

Seed.	Percentage of Germination. Average.		Max.	Min.	Percentage of 1931 Samples germinating in Groups—				
	1931.	1930.	1931.	1931.	Below 60.	60–69.	70–79.	80–89.	90–100.
Swede ..	82	84	99	Nil	11	7	11	28	43
Turnip ..	90	89	99	1	2	3	7	21	67
Rape	92	93	99	33	1	..	4	24	71
Kale* ..	84	80	98	8	7	3	11	32	47
Mangel ..	80	64	96	Nil	13	5	14	34	34
Carrot† ..	71	66	89	23	33	26	30	11	..

* Includes chou moellier. † Garden and field varieties.

Cereals, Vegetables, etc.

The average percentage of germinations of cereals, vegetables, &c., are shown under the various headings as below :—

Cereals, &c.

	Per Cent.		Per Cent.		Per Cent.
Oats ..	81	Rye-corn ..	77	Flax (*Linum*) ..	86
Wheat ..	94	Tares ..	61	Blue lupin (*Lupinus angustifolia*) ..	89
Barley ..	77	Japanese millet ..	85		

Vegetables.

Asparagus ..	65	Cucumber ..	86	Radish ..	82
Beet ..	75	Lettuce ..	89	Rhubarb ..	62
Broccoli ..	73	Leek ..	77	Spinach ..	62
Beans ..	91	Marrow ..	86	Tomato ..	82
Cabbage ..	79	Melon ..	48	Endive ..	95
Carrot ..	71	Onion ..	73	Squash ..	64
Cauliflower ..	73	Pumpkin ..	97	Parsley ..	58
Celery ..	84	Peas ..	90	Brussel sprouts ..	93
Cress ..	94	Parsnip ..	62		

Flowers.

Antirrhinum ..	68	Phlox ..	66	Sweet william ..	90
Lobelia ..	85	Portulacca ..	88	Sweet peas ..	89
Stock ..	33				

Exports and Imports of Grass and Clover Seeds, 1931.

Table 11 shows the quantities and values of the various seeds exported and imported for the year 1931, and the quantities only for the years 1928, 1929, and 1930.

Table 11.—New Zealand Exports and Imports of Grass and Clover Seeds, 1928 to 1931.

Seed.	1928.	1929.	1930.	1931.		Increase or Decrease compared with 1930.
				Quantity.	Value.	
Exports.						
	Cwt.	Cwt.	Cwt.	Cwt.	£	Per Cent.
Red clover ..	1,495	994	2,393	3,224	12,422	+ 49
White clover ..	835	1,302	1,920	2,841	20,658	+ 32
Other clover ..	350	687	784	241	1,297	− 72
Total clovers	2,680	2,983	5,097	6,306	34,377	+ 23
Brown-top ..	1,131	3,473	4,697	2,496	13,474	− 47
Chewings fescue	17,124	16,888	12,806	14,860	71,757	+ 16
Crested dogstail	4,844	4,500	4,656	3,230	10,477	− 30
Rye-grass ..	20,581	25,915	5,954	9,398	11,728	+ 36
Cocksfoot ..	496	1,183	669	2,948	9,835	+300
Other grasses ..	3,382	3,116	2,681	1,810	3,805	− 32
Total grasses	47,558	55,075	31,463	34,742	121,076	+ 14
Total quantity	50,238	58,058	36,560	41,048	..	+ 12
	£	£	£			
Total value	161,456	182,537	166,237	..	155,453	− 6

Table 11—continued.

Seed.	1928.	1929.	1930.	1931. Quantity.	1931. Value.	Increase or Decrease compared with 1930.
			Imports.			
	Cwt.	Cwt.	Cwt.	Cwt.	£	Per Cent.
Red clover ..	762	1,288	712	166	490	..
White clover ..	1,748	1,258	345	24	174	..
Alsike	2,806	1,417	2,040	81	261	..
Other clovers .	1,497	751	1,005	609	3,027	..
Total clovers	6,813	4,714	4,102	880	3,952	− 80
Cocksfoot ..	9,145	4,199	230	74	265	..
Lucerne ..	17	50	294	37	268	..
Paspalum ..	3,026	2,615	1,350	572	3,607	..
Poa pratensis ..	51	248	201	50	208	..
Rye-grass ..	20	855	4,347	348	651	..
Timothy ..	4,765	2,843	2,351	1,786	2,712	..
Other grasses ..	1,839	1,332	444	509	2,127	..
Total grasses	18,863	12,142	9,217	3,376	9,838	− 63
Total quantity	25,676	16,856	13,319	4,256	..	− 68
Total value	£ 101,373	£ 78,418	£ 42,407	..	13,790	− 67

Exports—The percentages of increase or decrease are shown for each kind of seed in the right-hand column. The most serious decrease is shown for brown-top and crested dogstail, while there was a substantial increase for cocksfoot and rye-grass. Although the quantity of rye-grass exported is still very much lower than it was prior to 1930, there is an overall increase in quantity of 12 per cent., but this is partly offset by a decrease in value of 6 per cent.

Imports.—A heavy fall in imports is shown for all seeds with the exception of "other grasses." A total decrease of 68 per cent. in quantity and 67 per cent. in value from the figures for 1930 constitutes the largest fall in seed imports for many years.

The assistance of Mr. J. Watt, of the Seed-station staff, in the preparation of the tabulations used in the this report is cordially acknowledged.

Superphosphate and Sweet Vernal.—A Fields Division officer reports that a paddock on a farm at Springbank (Canterbury), on light shingly land, had run to sweet vernal. Strips of this field were top-dressed with super at rates of 4 cwt., 2 cwt., and 1 cwt. per acre. The application of super evidently made the sweet vernal more palatable than on the undressed areas, as the manured strips, especially the 4 cwt., were completely grazed down by sheep, leaving no seed-heads, while the unmanured area had a growth of 3 in. to 4 in., with a crop of seed-heads.

SEASONAL NOTES.

THE FARM.

Balanced Pasture-management necessary.

At this season consideration may opportunely be given to the fact that good pasture-management results from suitable blending and balancing of the influence of several separate practices. From this it follows that judicious attention and expense given to any particular practice may be partly or even wholly wasted if it is not suitably linked with attention to those other practices which should operate in association.

A topical instance is provided in really sound autumn or spring top-dressing not being fully effective, because its subsequent influence is not controlled and modified properly. It is well known that two adjacent farmers could obtain very diverse results from identical top-dressing programmes, even though they started with similar pastures. Frequently top-dressing not only meets the need of more feed for our stock, but also at the same time creates the need of measures which will deal effectively with the additional feed which it provides. Top-dressing normally results in the production not only of extra feed when it is badly needed, but also of extra feed when there would be sufficient without top-dressing. If this latter additional feed is not suitably used, and if it is allowed to lead, in late spring and summer, to the development of coarse stemmy growth, then the benefit conferred at one season by the top-dressing may be nearly, or even more than, counterbalanced by the undesirable later results.

Hence occasionally we find farmers condemning top-dressing without any real justification for doing so. If their experience is studied it will usually be found that top-dressing has done all that could reasonably be expected from it—it has created the extra growth. It is the farmer who is condemning it who has really failed—failed in not linking the top-dressing with other measures which will utilize properly the extra growth that has been produced.

This relation between top-dressing and other pasture practices is especially topical because between early spring and late spring there may readily occur, if weather conditions are favourable, a transition from bare and backward pastures to rapidly growing pastures producing feed in excess of the current requirements of the stock being carried. In such rapidly growing spring pastures originates much of the poor summer grazing management which leads to relatively unsatisfactory returns from top-dressing and other practices which in themselves are judicious means of increasing growth. Incidentally, it follows from the above considerations that the ultimate success of a top-dressing programme is dependent on the farmer as well as on the farm. Indeed, it would probably be safe to state that the full success of top-dressing is often dependent more on the farmer who applies it than on the farm to which it is applied.

The position may be summed up by saying that top-dressing properly fitted into a system of pasture-management may serve excellently to increase the amount of leafy growth that is so desirable, but if not suitably accompanied by other measures it may lead to earlier development of coarse stemmy growth, the reverse of the leafy growth which is desired. While poorly controlled summer growth commonly occurs in pastures which have not been top-dressed as well as on those which have been top-dressed, that on the top-dressed ones is almost certainly of more importance, because if it is not effectively handled the best possible returns from the outlay on top-dressing are not obtained.

Importance of proper Utilization of Pastures.

The preceding consideration indicates that in the approaching season of rapid growth the practices that beget effective utilization of pasture are of great importance. During recent years much attention has been given rightly to the task of increasing production, until the position reached on many farms is one in which the production of grass growth is more efficient than its utilization. The most important general feature of this position is that many farmers still do not realize that their utilization is relatively inefficient in the light of modern knowledge.

One of the prime causes of unsatisfactory utilization of pastures is the allowing of the growth to become too rank and mature during spring and summer. In comparison with leafy growth, rank stemmy growth is poor in the milk- and flesh-forming compounds called proteins ; poor in mineral matter required in milk- and bone-formation ; and poor in digestibility. In brief, the rank stemmy growth is poor in three characteristics in which feed suitable for butterfat and fat-lamb production requires to be good. Sheep-farmers generally know well that pasture growth of considerable length and maturity gives very unsatisfactory results in the grazing of sheep, and especially in recent years has it been realized that such growth is equally undesirable in the grazing of dairy cattle. To some farmers these facts may seem so well known as to make it somewhat futile to direct attention to them, but the position to be faced is that they are important facts, and that thousands of farmers take no special steps to apply them in their pasture-management.

The two main means of avoiding the excessive maturity of pasture growth that leads to poor-quality feed are ensilage and systematic grazing, both of which should be in operation on many farms in the immediate future.

Reasonably good grazing management can be secured often on farms subdivided into from nine to twelve paddocks, exclusive of specially small paddocks for pigs, calves, &c., but frequently a greater number of paddocks would facilitate improved results. Hence many farmers who do not practise systematic grazing cannot advance lack of subdivision as a real reason for not doing so, for their farms are already subdivided closely enough to allow of much better grazing measures than they follow.

The essential steps in effective grazing on many farms are the following simple ones : (1) Rapid grazing of fields by relatively heavy stocking so that the duration of a grazing period is generally from one to three days ; (2) subsequent " spelling " of the pastures to allow of recovery sufficient to give the amount of grazing already specified.

To enable successive grazing to take place at a suitable stage of growth it becomes necessary from time to time to drop out of the grazing programme any paddocks in excess of those required to meet the current feed requirements of the stock. It is the dropping of these paddocks which provides the scope for ensilage, for as the season advances it usually happens that more paddocks are dropped from the grazing than could be effectively utilized for haymaking.

Levelling out the Year's Feed Supply.

On all farms except those on which arable crops are dominant a matter of prime practical importance at this time of the year is the variation in the rate of pasture growth between one season of the year and another. When pastures are being considered as a direct source of stock feed the following facts relative to this variation are of moment : (1) The variation arises primarily because of differences either of soil-moisture or of soil-temperature ; (2) normally, farmers cannot exercise control over soil-moisture and soil-temperature sufficient to influence materially the pastures in a way that will even out the natural seasonal differences in their rate of growth.

The seasonal variation is so great that approximately 70 to 75 per cent. of the whole year's growth occurs in the period of four months' duration commencing about the middle of September. This variation constitutes a fundamental weakness in grassland as a sole direct source of stock-feed, since because of it, feed production from season to season does not coincide with the feed consumption that would give efficient feeding of farm stock throughout the year. Unless proper steps are taken to deal with the position, either the stock are subject to alternate periods of abundance and of scarcity, or the farm is understocked so that the stock carried may subsist during the period of low production, and feed is wasted during late spring and summer, or extra stock, which give relatively poor returns, are then bought in. The measures which usually meet the position effectively—ensilage and special cropping—are ones for which preparation usually should be in progress about this time.

The two main tasks relative to ensilage that at this stage call for attention are (1) the closing up of suitable pastures, which was discussed in last month's notes; (2) the construction of pits or trenches if these are still to be formed. Suitable sites for pits or trenches occur on a great many farms. If convenient terraces on which pits can be placed are not available, then it is often advisable to resort to trenches, which if necessary can often be satisfactorily located on level paddocks. In trenches, which are essentially shallow pits, silage has been conserved with wastage so slight as to be negligible. When the pit or trench system of ensilage can be adopted, it usually should be employed, as it minimizes wastage of crop material and is low in labour and equipment demands.

Special Cropping.

The general remarks relative to special forage-crops which appeared in last month's notes are applicable to current work. Of the crops therein mentioned the mangel is one which deserves special mention. A point about which many farmers seem to have incorrect views is the cost of the mangel. Although the mangel is a fairly expensive crop, it is not nearly so costly as some farmers seem to believe. Apart from specially abnormal conditions the total cost ranges from about £8 to £11 an acre, allowing standard charges for all cultural operations, materials, and rent. On the basis of the charges allowed in this estimate, a crop of 50 to 60 tons an acre should result. It is when the feeding-value of this crop is set against the cost that the true economy of the crop becomes fully evident. Assuming a 50-ton crop at a cost of £10 an acre, the cost becomes 4s. a ton. That the mangel is potentially a very cheap source of feed is made clear by considering this estimated cost in conjunction with the fact that when hay is worth £3 a ton, then on a feed-value basis mangels are worth 10s. a ton. It is of considerable practicable importance that many of the items included in a total estimated cost of £8 to £11 an acre would not call for direct outlay on a great many farms. Indeed, on many farms the direct extra outlay involved in growing a mangel crop would be less than £3 an acre.

The matters of seasonal importance regarding the mangel are: (1) It should be grown much more extensively, because it is potentially a very cheap source of winter and spring feed both for dairying and sheep-farming; (2) it responds profitably to high fertility, so that land intended for mangels, if not naturally rich, should be made so by the use of farm or artificial manure or both; (3) correlated with its response to high fertility is its profitable response to abundant cultivation both before and after seed-sowing.

Lucerne.

Because the outstanding merits of lucerne warrant for it much more attention than it has received, and because preparatory cultivation for lucerne establishment should soon be started, if it is not already under

way, it seems opportune to advise all interested that the needs, potentialities, and general management of this crop are discussed at length in the Department's recently published bulletin No. 155, "Lucerne on the Farm," which may be obtained free.

Potato-growing.

Over wide areas the main crop of potatoes may very suitably be planted in October. Successful crops of potatoes are most generally secured on rich open loams which have been left in a loose condition by cultivation. Three of the outstanding factors in success with the potato are: (1) The use of good seed—the fullest information on this point should be secured by all growers in view of relatively recent developments in regard to virus troubles and seed certification; (2) liberal manuring of the land to be used, if not naturally rich—even on rich soils fairly substantial dressings of superphosphate usually prove profitable; (3) adequate cultivation to provide a well pulverized relatively loose seed-bed.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Spraying Operations.

Stone Fruits.—With the first appearance of aphis, either green or black, Black Leaf 40 should be applied at a strength of 1 in 800. Where it is intended to apply this wash alone the addition of soap (4 lb. per 100 gallons), hydrated lime, or casein spreader (1½ lb. per 100 gallons) will be necessary to release the nicotine. Should the application be made in conjunction with lime-sulphur (0·1 per cent. polysulphide content), as is done by some growers, there will be no need to add the soap or other materials. It is suggested that 1 pint of Black Leaf 40 be placed in 4 gallons of water to which has been added one of these materials, allowed to stand for fifteen to twenty minutes, and then placed in the spray-tank. More efficient control is obtained with the use of Black Leaf 40 if applied on a hot day, consequently the delay of a day or so may be advisable to await suitable conditions.

Apples.—What is considered by many to be the key application of late spring and summer for the control of codlin-moth, leaf-hopper, black-spot, and powdery mildew, is the calyx spray. It is advisable to apply this spray, if possible, before all the blossoms have fallen; this is essential with large areas, so that the application can be completed before the calyx lobes close. Apart from the desirability of depositing some of the arsenate of lead in the calyx end this early application is necessary where mildew is to be controlled and where leaf-hopper has made its appearance. The mixture recommended is water 100 gallons, arsenate of lead 1½ lb., colloidal sulphur 2 to 3 lb., spreader ¼ to ½ lb., Black Leaf 40 1 pint, lime-sulphur 0·1 per cent. (polysulphide content). This mixture, with the elimination of Black Leaf 40, is also suitable for pears.

Cultivation and Irrigation.

The working down of the soil into good tilth for the summer will now be one of the major operations.

At time of writing (31st August), the dry spell still continues in Central Otago, the rainfall for May, June, July, and August totalling approximately only 1½ in., and for the first eight months of the year about 7 in. In consequence, irrigators should take advantage of the larger supply of water available in the early part of the season, so as to bring the soil into a reasonably moist condition.

The Orchardist's Nursery.

Apple stocks, mentioned in last month's notes, will have been lined out in nursery rows. The ground requires to be kept in good tilth, but care must be taken when hoeing or cultivating between rows not to disturb the grafts before a proper union has been made. These should be fit for transplanting during next winter in the nursery, where they will be worked over, either by budding the following summer or grafting twelve months hence.

Peach and apricot pits will require attention as soon as the seedlings are large enough to handle—say, 2 or 3 in. high. They should be carefully lifted with a garden trowel and planted in the nursery, as mentioned in July notes. If the soil is kept worked and growth encouraged many should be ready for budding in late summer or early autumn. Plum seedlings and cuttings that are starting to move should be kept worked between the rows. Every care should be taken not to touch them with the hoe, as the slightest jar will prevent them from rooting. For 3 in. or 4 in. from the ground, growths should from time to time be removed on the peaches, apricots, and plums; this will create a clean stem for budding.

Grafting.

The correct season for grafting is governed by the condition of the stock and scion; the former should be well on the move and making their first growths, and the latter still dormant. Much of this work is done during September and early October.

Frost Prevention.

An increasing number of growers are successfully adopting the oil firepot system for protecting their fruit crops and tomato plants from late spring frosts. No system is complete without a frost alarm, as the work is too exacting on the grower, both mentally and physically, for him to rely on alarm clocks or the prognostication of probable frosty nights. Considerable information on this subject has been published in earlier issues of the *Journal*, copies of which are still available, and further advice can be supplied by the Department to those applying for it.

—*W. R. L. Williams, Orchard Instructor, Alexandra.*

Citrus Culture.

Spraying: As the trees are now in active growth there will be very little danger of damage to the foliage by the use of an oil spray for the control of scales and other sucking insects. An oil emulsion should be applied as soon as the young growth has hardened. The use of white oils is now becoming general at a strength of 1–60 and 1–80, according to the brand. These oils are readily mixed, and there is not the same danger of any free particles of oil that often caused injury to the foliage when the ordinary red spraying oil was used. Moreover, they give a much more effective control.

Bordeaux 4–4–40 should also be sprayed when the bulk of the main spring blossoms have fallen, as a preventive of verrucosis and grey-scab. Later sprays at intervals of from three to four weeks should also be given in order to protect the young fruit.

Where thrips are in evidence Black Leaf 40 1–800 should be added to the bordeaux. It is evident that this pest is beginning to get troublesome in some localities, and growers should watch for its appearance and spray for its control.

Manuring: This season of the year is one of the best periods at which to apply manures. The quantity to be used would largely depend upon the age and size of the trees, soil conditions, and general state of the

orchard. Individual trees should always have attention. Young trees up to six years old should receive about 2 lb. of blood and bone with the addition of a small quantity of sulphate of potash. Trees that are bearing consistent crops should receive a much more liberal dressing of this mixture, with possibly the addition of some sulphate of ammonia. Whether the manures should be spread over the whole of the soil area or confined within a certain radius is a point upon which there is a great diversity of opinion. However, it is always advisable to confine it to within a limited circle for young trees, gradually extending as the trees get larger. After application, the manure should always be worked into the soil as soon as possible.

Cultivation · With the renewed activity of the trees during spring a fair amount of wood growth may be expected. This, of course, means root action also, consequently cultivation of the soil should have every attention. Where this is neglected it will very soon be reflected in the condition and health of the trees. The aim should be to cultivate the soil several inches deep right up to the tree, as cultivation of the surface soil will keep the roots to a lower level, while it will also conserve the moisture and thus enable correct functioning of the feeding roots.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Care of the Young Stock.

THE end of October should see all chickens hatched, if they are to have sufficient stamina to withstand the heat of the summer and make satisfactory development by the time the season of high-priced eggs arrives. It is a common experience for late-hatched chicks to grow well for a time, but when the hot weather arrives to make slow development, and in consequence to have a stunted appearance.

The necessity for feeding the young birds well and managing them with every care cannot be overstressed. Shade is a matter which must not be neglected ; it is the only hope for late-hatched stock, but it is also essential for birds of every age. Green food is also an essential requirement for healthy development. Shelled oats are always a valuable addition in the diet of the growing birds. Gravel grit should be in reach of the chickens at all times, likewise broken oyster-shell ; the former assists the birds to digest their food, while the latter is essential to provide lime for bodily requirements.

Every care should be taken to make houses fit to receive young stock after being transferred from the brooder, and to guard the birds against receiving any set-back. The houses should be thoroughly sprayed with a good disinfectant, and be otherwise made as sweet and clean as possible. Great importance attaches to having a fresh run for the chickens when they leave the brooder—a run that has been spelled for some time, especially where late-hatched birds are concerned. It is invariably the case that chickens will develop much more rapidly on such a run than they will on stale ground and grass.

Prevention of Disease.

It has frequently been emphasized in these notes that there is no satisfactory cure for advanced disease in poultry stock. Prevention is the one thing to aim at, and the first essential in this connection is to see that the birds possess the necessary constitution to ward off disease should this unfortunately appear. Possessing birds bred with the desired vigour, there is really no special skill required in maintaining them in a healthy condition. The next essential is cleanliness, and clean quarters and

surroundings must go hand in hand with good feeding—a plentiful supply of good nourishing food. Fresh air in the sleeping quarters is also important if disease is to be kept off, but it should be remembered that airy quarters do not imply a draughty building.

It is not on the properly managed poultry-plant that disease makes its unwelcome appearance, even where there are hundreds of birds run on an acre of ground. Disease is mostly found where the birds are accommodated in insanitary, draughty buildings, and are kept year after year on stale ground which is never purified by being turned up to the influence of the sun, sown down, and allowed to rest; on such plants, moreover, the birds are seldom fed and attended to as they should be.

In all branches of live-stock breeding the maintenance of constitution is recognized as the foundation stone, but with the high-type laying-fowl, upon which there is such an exceptional strain, constitution is of special significance. Constitution will never be maintained in a flock if the young stock bred of a laying strain are subjected to lice-infested quarters, stale runs, and low feeding, or, in other words, are subjected to conditions which may be regarded as inviting disease.

Disadvantages of Movable Houses.

Several times recently inquirers have asked if it would not be preferable to have movable houses for farm poultry instead of a fixed structure, as with the former the birds would pick up a good part of their living. To my mind there is nothing to be said in favour of having portable houses. It may be true that under special local conditions the birds would scratch up a part of their living in the form of insect life, fallen grain, seeds, &c., but as against this, the movable houses would make the work of attention, feeding, and watering, so heavy that the cost would counterbalance any possible advantage from free foraging. I have seen the movable house system adopted with four houses in a fairly large field. The result was that at feeding-time all the birds would be congregated near the gate through which the attendant entered with the food, while many would wander to the farmhouse, and, losing their bearings, would be found roosting in the trees and stables. Again, where the birds left their houses to be fed, it often happened that in the event of a rainstorm they all rushed into the nearest house, which would be overcrowded, while the others would be empty or have but a few birds in them. Where portable houses are employed the labour is considerable, and in wet weather is most disagreeable.

To get eggs in winter the birds should be provided with roomy scratching quarters and be fed inside, to obviate their having to wait about outside, possibly in heavy rain, for their feed. This is impossible with movable houses. With the accommodation handy, concentrated, and near the homestead, the women-folk of the farm can attend to the feeding and watering of the birds in comfort and in any weather, while the eggs can be frequently gathered and be obtained in a clean condition. With portable houses and a free range the hens are encouraged to lay anywhere, with the result that the eggs are too often stale and dirty, and cannot be marketed with confidence. The portable house, from a general point of view, is at its best when used only in the warm months of the year for growing-stock, after they have been transferred from the brooder.

Corns.

The most common cause of corns in poultry is continuous hard pressure on the feet, such as is caused by the birds being compelled to exercise on hard or stony runs, or in flying down from a high perch to a hard floor. They are also sometimes brought about by a prick from a thorn when the birds are on free range, or when thistles, pieces of gorse, &c., have been among the litter used in the house. When corns are giving trouble the

only effective course is to find the cause, if possible, and remove it. The perches should not be higher than 18 in. from the floor of the house, and the floor should be covered to a depth of several inches with straw or similar material to provide a soft place for the birds to land when leaving the perches.

When a bird becomes affected with a corn, and is considered to be of sufficient value to receive personal attention, painting with iodine is a simple and often effective treatment. Another method is to treat with a bluestone solution. Dissolve a piece of bluestone about the size of a walnut in a pint of hot water, and when the solution is cool dip the affected foot into it, repeating this treatment daily for a week or more. Many poultry-keepers lance the foot immediately a corn is detected. This is not only a cruel practice, but it seldom has the desired effect. The corn or abscess should not be interfered with until it has reached a perfectly ripe condition, and at this stage it will probably make its appearance between the toes as well as on the ball of the foot. From these places the dry pus can be easily picked out by means of a small-bladed penknife. After this operation a few drops of peroxide of hydrogen may be dropped into the affected parts. In order to keep the wound clean the foot should be bandaged and kept soft with vaseline or similar preparation. The bird should not be allowed to perch, and should be provided with soft bedding until a cure is effected.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Artificial Feeding.

As advised previously, a strict watch should be kept on the food-supply. As the spring advances this matter becomes of paramount importance. On no account allow the stores to dwindle. The queen's laying-powers are to a large extend automatic—as she is fed so will she lay—and when food is abundant brood-rearing will be in proportion. Do not forget that artificial feeding is invariably stimulating, and once undertaken must be carried out regularly and systematically. It is poor policy to fill a hive with brood and then leave it to starve. Spring losses are usually due to lack of stores, and are therefore preventable on the part of the beekeeper. Feed sugar syrup only, in the proportion of 2 parts of water to 1 of sugar, and place in the feeder while slightly warm.

Providing Water.

In the absence of a natural supply, water should be provided. Bees require a good deal of water for brood-rearing throughout the whole season, and it often happens that numbers of bees are lost if water is not close at hand. Moreover, bees often become a nuisance at cattle-troughs and by congregating round domestic supplies. Where a large number of colonies are kept it is imperative that the beekeepers should see that the bees are well supplied.

Many contrivances are used for the purpose of supplying water. "Simplicity" feeders make excellent vessels for containing water, but they require to be filled frequently and occasionally cleansed. A good contrivance is to use a kerosene or petrol tin as follows: Having thoroughly cleansed the tin, punch in the bottom a hole about the size of a sixpence; through this hole pass a piece of clean rag so that the water will fall a drop at a time. Under the tin a container may be placed to catch the water, and this, if filled with sand, will afford an excellent watering-place for the

bees. The supply can be regulated according to the requirements of the apiary. Bees prefer to take water from damp situations, and they may often be noticed in numbers sucking water from the ground where there has been any overflow. Containers should be placed in a sheltered spot in the apiary.

Foul-brood.

At all times when examining the combs a strict watch should be kept for symptoms of disease. Beekeepers should never lose an opportunity of acquainting themselves with foul-brood in all its stages. At this season if isolated capped cells are discovered in frames which contain no other brood, these should be treated as suspicious and subjected to the test for foul-brood. If on opening the cell, when a sharp-pointed piece of stick is inserted, the dead imago can be lifted out complete in form, the beekeeper may conclude that if dry it is a case of starvation and if moist of chilled brood. If, however, the contents of the cell adhere to the point of the stick in a ropy ill-smelling mass, it may be concluded that the hive is diseased.

There is perhaps no surer indication of the presence of foul-brood in the hive than the objectionable smell of the decayed larvæ. Beekeepers who once recognize this odour will have no difficulty in detecting the disease in that stage. The last and most difficult form of foul-brood is the dry stage, and in this form it has baffled beekeepers of long standing. Only a careful examination can reveal its presence. The diseased larva, having dried to a scale, adheres to the lower side of the cell, and can be removed by scraping with a sharp-pointed instrument. If the aforesaid isolated capped cells on being opened appear at the first glance to be empty, they will almost invariably yield a scale if examined, and the hive should be marked for treatment.

There is a deeply rooted notion among beekeepers that foul-brood can be detected outside by the odour, and inexperienced beekeepers are often misled by this statement However, where the glue-like smell is noticeable from the outside of the hive at a distance of a few feet it may be concluded that the colony is diseased beyond redemption. Fortunately such cases are rare.

Apiary Locations.

Perhaps there is no more important question for the beekeeper than location. Upon his ability to select a suitable district in which to start beekeeping will depend his future success. There are few districts in the Dominion where bees cannot be kept in small numbers, but successful establishment of a commercial apiary will largely depend upon the beekeepers knowledge of the nectar-secreting plants. It is generally recognized that the main nectar-flow in New Zealand is produced from white clover and catsear, but it will be found to be a distinct advantage if the apiary is established in a district near patches of native bush or where the golden willow is abundant. Most of the indigenous trees and willows flower early, and the nectar from these sources is very valuable to the beekeeper, as it provides ample stores in the spring.

In districts where the beekeeper has to depend entirely upon white clover a careful watch must be kept on the stores, and very often artificial feeding has to be carried on until the appearance of the clover-bloom. This is often expensive, and can be usually avoided by selecting a site where at least a moderate spring flow may be anticipated. The rich dairy pastures of both the North and South Islands, and localities where cattle-raising is carried on extensively, provide suitable sites for commercial apiaries, while country which is used for sheep-grazing is generally not profitable, as the clover pasture is usually eaten bare. Instances have come

under my notice where abnormal crops have been secured in purely sheep-country, but they are too infrequent to be taken into consideration, and consequently this class of country should be avoided. Essentially the main requirements are feed and shelter, and if the apiarist is fortunate enough to locate his bees in a position where there is an abundant supply of nectar-secreting plants, good shelter can be easily provided.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

OCTOBER sowings will include the half-hardy crops of dwarf and runner beans; the gourds—marrows, pumpkins, cucumbers, and melons; also the winter crops of savoy, red cabbage, kale, brocolli, cauliflower, leeks, and celery for planting out early in the New Year. These are all important crops and should be grown where the land is suitable.

Beans may be used in the pod, shelled, or dry. In the latter form the white, light green, and pale dun haricots are a popular nutritious vegetable. Stained seeds for sowing should be regarded with suspicion as possibly being infected with the bacterial wilt disease which has recently made its appearance here. If they are affected the trouble will soon develop in the young plants, with results fatal to cropping. A light, rich, warm soil is most suitable for this crop, and, where lime has been used, a dressing of an ounce or two of superphosphate to the square yard will be beneficial. Sow thinly—3 in. or 4 in. apart is not too wide—and leave about 2 ft. between the rows of dwarf varieties. The depth of the drills should be 2 in. or 3 in., the latter being adopted in the case of light land. The runner bean is of altogether a different botanical species from the kidney or French bean; it is a perennial plant, while the latter is an annual. For this reason runner beans may be planted where they can be cropped for two or three years before resowing in a fresh locality.

The ideal soil for gourds is friable, rich, moist, and really well-drained. Melons require also a warm climate; but even where that condition is present this delicious fruit is little grown except by our Native people, who raise very handsome specimens of rock and water melons. Apply 3 oz. or 4 oz. of a "complete" manure to the square yard, and sow ridge cucumbers and rock-melons 12 in. to 18 in. apart, with 5 ft. or 6 ft. between the drills. Water and pie melons, citrons, marrows, and pumpkins may be thinned to 3 ft. or 4 ft. in the drill, with 8 ft. or 10 ft. between the rows. Where a little shelter is needed to protect the plants in the early stages, a small sheet of oiled paper may be used. It should be supported with a couple of wire hoops to keep it off the ground, and a little soil placed round the edges to keep it in position. When the time comes to harden off the plants, lift the paper on the lee side for a while, after which it may be removed altogether.

For cabbage, kale, and other plants of this family beforementioned for winter cropping, fork over a piece of land in a sheltered place; give it a dressing of lime, and sow the seeds thinly, broadcast, and rake well in. A few branches of scrub laid on the surface of these seed-beds will afford shade and protection from birds until germination takes place.

Leeks and celery should also be sown to raise plants for setting out in December and January; any soil that is really rich and moist will suit these crops. The fine celery seed is usually sown thinly in boxes of light soil, and the plants are afterwards pricked out at a distance of about 2 in. apart; but it may be grown outside so long as the plants are pricked out to destroy the tap roots and induce good rooting. It should be remembered

that celery is a water-plant, and should never be allowed to become dry. Owing to the prevalence of leaf-spot fungus, it is usually necessary to spray the plants with summer strength bordeaux spray in the seed-beds and after setting them out.

Weeds and grass in odd corners may be mown from time to time before seeding, and placed in a pit to ferment with other waste of the kind that usually accumulates. It should be spread evenly and trodden down compactly to assist fermentation. In winter it will turn out much like ensilage, and, with green crops grown for turning under, it will maintain the supply of humus in the soil that is so necessary. There is the further advantage of keeping the place in better working-order and checking the spread of weeds by seeding.

For pot-plants and boxes of seedlings success depends chiefly on a good friable compost in sweet condition being available. This can only be obtained by special preparation a year or so before it is required. The main ingredient is a good fibrous turf, growing on a loam of good quality. It should be stacked compactly in a moist, well-drained position where it will decay, sweeten, and become friable by the time it is required. If it is inclined to lack humus the old hotbed manure may be incorporated in alternate layers. Any opportunities for obtaining these supplies for making a good compost heap should now be taken.

Tomatoes, Egg-plants, and Peppers.

Egg-plants and peppers are both rather more tender than the tomato plant; they should be planted out somewhat later when the danger from low temperatures is quite past, and given a sheltered position in the warmer localities. Set out about 18 in. apart with tips removed when about 6 in. high to make them branch out; they require very little further attention, except for a little feeding when the fruit is set.

The most critical operation with these half-hardy plants for outside cropping is that of hardening them off. If this is done suddenly they become stunted and take a long time to recover from the check. The boxes of plants should be prepared for the operation in the glasshouse by gradually lowering the temperature and keeping them slightly drier. They may then be removed to the cradles for hardening off during a period when fine weather may be expected. Careful attention for the ensuing fortnight should turn them out in good hardy condition for planting out for cropping. The last attention given should be a generous application of water the day before they are transplanted.

If the land is well charged with humus in a decayed condition, a dressing of bonedust has been ploughed under, and liming has been attended to, a moderate dressing of superphosphate shortly before planting is all that is usually necessary. Heavy dressings of manures, especially when the preceding crop has been generously treated, is a waste of money and predisposes the plants to disease, especially that known as stripe disease. The plants should be set deep and firm during good weather and when the soil is in a sufficiently dry friable state.

Under glass the tomato crop will be setting the fruit, and the success of this critical period of development depends very largely on maintaining a suitable atmosphere. Cold draughts, close humid conditions, and any sudden changes are inimical. Watering, when necessary, should be done in the morning; excessively high or low temperatures should be anticipated and the ventilators adjusted to maintain a warm buoyant atmosphere. In warm districts a little ventilation will be required now even at night. Unless glasshouse crops can be given this close attention they are rarely profitable.

Small-fruit Crops.

The cultivation between rows of bush fruits to suppress weeds and superfluous suckers and runners should be very shallow, as the fibrous roots are very near the surface, and any injury to them at this critical stage interferes with growth and fruit development. Strawberries may now be given a dressing of nitrogenous manure with advantage, just before applying the mulch. For the latter purpose clean baled straw that has been weathered to destroy seeds is very suitable, rushes and pine-needles are also sometimes used. To keep the berries free from grit thrown up by splashing rain something of this kind is usually necessary.

The Homestead Garden.

If flowering shrubs are studied it will be noticed that they flower best on the old wood ; or young wood, that is, one-year-old wood , or the new wood, as do roses. On this chiefly the pruning treatment required depends. Early flowering shrubs of importance that carry their blossom on the young wood are the forsythias, lilacs, double-flowering peaches, the banksia rose, &c. These and others of their class are greatly benefited by cutting away the wood as soon as it has flowered, in order to admit light and air which are so necessary to the young growth that follows and is to flower next season. If favourites are given this attention their gratitude will be generously expressed by the enhanced display that will follow. Suckers also should be suppressed, as they represent so much energy wasted, and they diminish the light and air so necessary to develop flower buds. For this important reason all rank superfluous growth inclined to crowd the plants should be suppressed.

As the time is arriving for setting out summer bedding-plants, some preparation should be made. The fragrant stocks, the glowing zinnias, and the delicately-coloured asters each have their appeal and provide wholesome pleasure when well grown. This is best attained by strictly limiting the area planted and doing it well. The foreground of the shrubbery border so often used is rarely suitable, as the interests of the respective crops often seriously clash. As the name bedding-plants indicates, they are best grown in beds or borders specially set aside for the purpose so that the proper treatment may be given. With the continuous cropping these beds receive, there is a danger of them becoming deficient in humus, without which good results cannot be obtained. It may be supplied now by turning in a good supply of decayed farm manure. If 3 oz. or 4 oz. of bonedust to the square yard is included, success should be assured if good plants are set out in a tasteful manner. An ounce or two of superphosphate to the square yard, hoed in shortly before planting, would supply their more immediate need for phosphates.

Good plants are dwarf, bushy, and well rooted. It is important they should be well hardened off and not suddenly transferred from the glass-house or hotbed, which would cause them to become stunted in their growth. Cheap plants are very tempting, and the assurance that they will make good is very plausible ; but the practice previously advised to limit the area and do it well is the best policy.

—*W. C. Hyde, Horticulturist, Wellington.*

Sodium Chlorate and Piripiri.—By one summer spraying of 3-per-cent. sodium chlorate a farmer at Paraparaumu last season substantially reduced piripiri, though without eradicating it.

Ridding Broad Beans of Aphis.—A Dunedin gardener states that he has achieved excellent results in ridding broad beans of black aphis by spraying them with a solution made by dissolving a few packets of Epsom salts in a bucket of water. The solution in no way harmed the plants and they did not become reinfested.

WEATHER RECORDS: AUGUST, 1932.

Dominion Meteorological Office.

August was a cold month in all parts of the Dominion, but in the latter half there were a number of mild days. Rainfall was still below average over the greater part of the Dominion, but the heavy rain from the 27th to the 29th caused a considerable excess in most of Taranaki and in Southern Wellington. The low temperatures were mitigated by the abundance of bright sunshine.

Rainfall.—In the South Island only scattered parts of Canterbury and Otago had more than the normal rainfall. In the North Island, in addition to the areas above mentioned, parts of the Auckland Peninsula had more than the average. In Hawke's Bay and at many other places the month was a very dry one.

Temperatures.—The temperature was everywhere from one and a half to three degrees below normal. There were many severe frosts in the first half of the month and from the 22nd to the 26th.

Sunshine.—All parts had more sunshine than usual. Nelson recorded 233·7 hours and Blenheim 218·1 hours, while the total of 208 hours at Waimate was very much above the average.

Pressure Systems.—The month began with a continuance of the same type of weather as had ruled during July. Depressions were mainly of cyclonic form, with the centres pursuing tracks which kept to the north of New Zealand. The most important of these cyclones passed Norfolk Island on the 3rd, and its passage coincided with that of a westerly depression to the southward. From Norfolk Island it moved in a south-easterly direction, becoming deeper in the process. The southerly winds in the rear of this depression were very cold and strong, and peculiarly persistent. On every day from the afternoon of the 2nd when they first reached the southernmost portion of New Zealand until the evening of the 6th when they finally died away, they brought hail, snow, and winds of gale force to many places. At first the full severity of the southerly was experienced only in the far South, but gradually it spread northwards. The 5th was a particularly bitter day. Snow fell down to low levels over an area covering the greater part of the South Island, and all the interior and the high levels of the North. Even at Thames and on the Hauraki Plains there was a light fall. The Wairarapa suffered relatively the most severely, snow commencing on the night of the 3rd and not ceasing finally until the 6th. The total fall was the heaviest since 1918.

On the 7th an anticyclone moved on to New Zealand, the highest pressures being experienced in the South Island. This anticyclone maintained its position until the 13th, when it began to move away eastward. Barometers were at times very high. Although cyclones still continued to pass by to the northwards, bringing unsettled weather to varying proportions of the North Island, the weather was otherwise very fine. Many severe frosts were experienced, especially in the South Island.

The anticyclone just mentioned was the precursor of a more springlike weather regime. Following it, depressions, though well developed, were of the normal westerly type. From the 13th to the 15th, as the first of these depressions approached, occurred the first really mild weather for a long period. On the 15th the northerly winds freshened, and rain became widespread in western and northern districts. By the time the depression had passed on the night of the 16th almost general rains had been recorded, with heavy falls in many places.

Another rather vigorous westerly depression passed during the 21st to 22nd. Rains were fairly extensive, especially in western districts and the North Island generally. In the southerly which followed this storm snowfalls were again fairly widespread.

The last storm of the month was a double westerly depression, the primary being followed by a secondary. It was not deep as it crossed the Tasman Sea on the 26th and 27th, but on the latter day a sharp rise of pressure and a change to southerly winds extended rapidly from Tasmania across the South Tasman Sea to Southern New Zealand. By the morning of the 28th the southerly invasion had covered the South Island but appeared to have expended itself. Over the North Island, however, the northerlies not only continued to blow but freshened. Throughout the 28th the situation remained almost unchanged, light southerly winds prevailing to just beyond Wellington, while above them and to the northward blew a strong northerly current of warm air heavily charged with moisture. As a result, torrential rains occurred in the southern portion of the Wellington Province and adjacent parts of Cloudy Bay and the Marlborough Sounds where the northerly

winds were forced to rise over the southerly. On the high levels and even in the Town of Masterton there was a fall of snow. On the 29th the southerlies became stronger and extended farther northward, and there were more heavy rains. Following these rains unusually severe floods occurred in the Wairarapa and Manawatu districts. From Masterton to Lake Wairarapa it was said to be the severest flood for twenty years. The weather improved on the 30th, and the 31st was perfect.

RAINFALL FOR AUGUST, 1932, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average August Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	3·71	13	1·24	5·21
Russell	3·76	12	1·26	4·78
Whangarei	3·08	20	0·71	6·46
Auckland	2·28	13	0·74	4·23
Hamilton	1·44	8	0·34	4·20
Rotorua	2·29	8	0·63	4·97
Kawhia	3·89	11	0·95	4·65
New Plymouth	5·57	14	1·45	5·46
Riversdale, Inglewood	13·20	12	4·89	8·80
Whangamomona	7·43	8	2·07	5·96
Eltham	10·46	10	3·23	5·07
Tairua	5·32	11	2·02	5·87
Tauranga	2·46	11	0·74	4·29
Maraehako Station, Opotiki	3·66	13	1·04	5·59
Gisborne	2·91	13	1·25	4·36
Taupo	2·46	10	0·86	4·12
Napier	0·89	16	0·22	3·50
Hastings	0·83	12	0·25	3·25
Taihape	1·94	11	0·77	2·81
Masterton	8·77	18	3·33	3·49
Patea	6·88	14	2·18	3·68
Wanganui	2·57	11	0·64	2·79
Foxton	4·00	7	2·05	2·90
Wellington	6·67	16	3·48	3·82
South Island.				
Westport	5·37	12	1·51	7·70
Greymouth	5·56	12	1·43	7·38
Hokitika	5·13	11	1·64	9·27
Ross	6·57	7	1·78	10·60
Arthur's Pass	7·05	5	2·30	11·76
Okuru	8·16	5	3·00	11·37
Collingwood	6·69	7	2·64	7·13
Nelson	2·51	8	1·06	3·03
Spring Creek	2·62	7	1·25	2·76
Hanmer Springs	3·30	10	0·74	3·41
Highfield, Waiau	2·60	8	0·85	2·45
Gore Bay	1·84	10	0·41	2·69
Christchurch	2·07	11	0·78	1·85
Timaru	1·31	8	0·60	1·48
Lambrook Station, Fairlie	1·55	8	0·62	1·53
Benmore Station, Clearburn	1·56	9	0·94	1·48
Oamaru	0·85	5	0·28	1·75
Queenstown	1·59	8	0·58	1·96
Clyde	0·49	4	0·19	0·80
Dunedin	1·77	9	0·46	3·09
Wendon	2·37	7	0·60	2·03
Gore	2·68	8	0·72	2·25
Invercargill	2·11	15	0·36	3·25
Puysegur Point	3·62	16	0·82	7·12
Half-moon Bay	1·87	12	0·52	4·53

GRADING OF EXPORT BUTTER AND CHEESE.

LEADING DAIRY-FACTORY AVERAGES FOR YEAR 1931–32.

LISTS of butter and cheese factory companies or proprietaries which have obtained for their export produce an average grade of 93 points or over for the past dairy year—1st August, 1931, to 31st July, 1932—are printed below. Eighty-seven butter-factories and twenty-five cheese-factories have gained a place in the lists this year, compared with eighty-four and twenty-one respectively for the previous year. Twenty-four butter-making companies averaged over 94 points, the highest individual average being 95·217. No cheese-manufacturing company obtained an average grade of 94 points, the highest average being 93·698. The lists include seventy-one butter companies whose produce is graded in the North Island, and sixteen butter and twenty-five cheese companies in the South Island.

Company or Proprietor.	Registered Number.	Brand.	Tonnage graded.	Average Grade.
Butter-factories.				
Taieri and Peninsula (Dunedin)	54	Peninsula	64	95·217
Kokatahi	1144	Kokatahi	149	94·746
Golden Bay	146	Sovereign	608	94·739
Rangitikei	1360	Rangitikei ..	670	94·725
Levin	910	Lake	1,147	94·623
Moa Farmers'	341	Inglewood.. ..	1,024	94·471
Mangorei	345	Mangorei	790	94·454
Wangaehu	1326	Wangaehu ..	415	94·454
Midhirst	110	Rugby	1,183	94·444
Lepperton	49	Lepperton.. ..	45	94·404
Rata	938	Rata	672	94·397
Inter-Wanganui ..	6	Inter-Wanganui ..	93	94·346
Uruti	300	Uruti	205	94·325
United	1296	Wharitі	117	94·275
Tarurutangi	728	Champion ..	95	94·272
Awahuri	664	Red Rose	689	94·211
Kaikoura	302	Kai	265	94·149
Maketawa	342	M.D.C.	256	94·140
Rongotea	8	Rongotea	642	94·066
Arahura	1516	Arahura	48	94·063
West Coast Farmers' ..	675	Silver Pine ..	55	94·055
Tikorangi	102	Shield	384	94·043
Rangiwahia	750	Quail	213	94·041
Shannon	1489	Shannon	871	94·007
Waitaki	812	Waitaki	14	93·978
Waitara	726	Waitara	479	93·966
Golden Coast	387	Golden Dawn ..	32	93·872
Tarata	631	Tarata	114	93·746
Farmers' Dairy Federation (Invercargill)	336	Murihiku	413	93·740
Apiti	414	Apiti	262	93·707
Golden Coast	991	Golden Coast ..	104	93·700
Okau	872	Okau	173	93·682
Bell Block	488	Bell Block ..	142	93·679
Okoia	413	Okoia	544	93·662
New Zealand (Ngatea) ..	291	Anchor, Acorn, &c...	1,500	93·654
Wairoa	1345	Wairoa	531	93·625
Omata	82	Omata	428	93·603
Te Aroha	344	Overseas, &c. ..	1,239	93·591
North Taranaki ..	723	Flax	457	93·586
Taihape	1188	Tikapu	198	93·541

LEADING FACTORY AVERAGES—*continued.*

Company or Proprietor.	Registered Number.	Brand.	Tonnage graded.	Average Grade.
Butter-factories—*continued.*				
Pio Pio	603	Pio Pio	485	93·522
Wellington Municipal Milk	202	Rahui	98	93·512
Kaitaia	1298	Kaitaia, Manuka ..	1,343	93·502
Stratford	68	Stratford	801	93·494
Opotiki	337	Opotiki	1,403	93·491
Kairanga	1768	Longburn	279	93·489
Co-operative of Otago ..	266	Huia, &c.	455	93·482
Raetihi	717	Raetihi	202	93·462
Farmers' Dairy Federation (Gore)	165	Gore	165	93·443
New Zealand (Frankton Junction)	1510	Anchor, Acorn, &c...	1,515	93·415
Hinuera	329	Hinuera	776	93·401
Hauraki Plains ..	1900	Hauraki Plains ..	2	93·365
Matakana	1375	Matakana ..	254	93·355
Cheltenham	3	Pakeha	1,725	93·349
Tauranga	1478	Tauranga	945	93·329
Bay of Islands ..	1312	Bay of Islands ..	875	93·315
Morrinsville	330	Lockerbie, &c. ..	1,947	93·313
Taieri and Peninsula (Oamaru)	1234	Taieri and Peninsula, &c.	159	93·301
Taihape	1188	Tikapu	234	93·300
New Zealand (Waharoa)	293	Anchor, Acorn, &c...	3,649	93·300
New Zealand (Waiuku) ..	111	Anchor, Acorn, &c...	2,168	93·290
Whakaronga	1709	Whakaronga ..	182	93·261
Kia Ora	926	Kia Ora	1,086	93·225
Hokianga	1843	Hokianga, &c. ..	1,025	93·225
Ruawai	66	Ruawai . ..	1,007	93·225
Kaikohe	40	Kaikohe	237	93·210
Hikurangi	303	Hikurangi, &c. ..	1,420	93·207
Waitaki (Dunedin) ..	1013	Waitaki	9	93·198
Norsewood	600	Norsewood ..	600	93·193
Northern Wairoa ..	1358	Northern Wairoa ..	2,149	93·193
Kaipara	794	Poplar, Filbert, &c	2,075	93·181
New Zealand (Paerata) ..	109	Anchor, Acorn ..	2,776	93·172
Kati Kati	1305	Kati Kati ..	554	93·166
Rangitaiki Plains ..	133	Rangitaiki Plains, &c.	2,924	93·140
Northern Wairoa ..	4	Northern Wairoa ..	571	93·133
Taupiri	43	Signal, Ensign, &c.	1,088	93·132
Caroline	236	Caroline	81	93·118
Alpine	792	Pine	18	93·110
Mid-Canterbury ..	35	I.X.L.	3	93·094
Murchison	1888	Airship	163	93·093
Whangarei	1720	Kauri, &c. ..	2,048	93·081
New Zealand Dairy Union	100	Hinemoa	595	93·075
Raglan	1470	Raglan	411	93·052
Springhead	180	Springhead ..	119	93·043
Tamaki	1463	Bell	252	93·021
East Tamaki	301	East Tamaki ..	1,527	93·000
Waipu	1248	Waipu	421	93·000
Cheese-factories.				
Barry's Bay	401	Onawe	191	93·698
Cam	168	Cam	67	93·623
Edendale	36	Pioneer	664	93·553
Milton	1030	Milton	105	93·512
Mabel	29	Mabel	147	93·412
Oware	662	Oware	154	93·403
Seaward Downs ..	702	Seaward Downs ..	508	93·375

LEADING FACTORY AVERAGES—*continued.*

Company or Proprietor.	Registered Number.	Brand.	Tonnage graded.	Average Grade.
		Cheese-factories—*continued.*		
Little Akaloa	32	Little Akaloa ..	56	93·355
Omimi	74	Omimi	79	93·261
Thornbury	1581	Thornbury ..	405	93·223
Brydone	1821	Brydone	387	93·189
Island	72	Island	450	93·173
Waianiwa	1171	Waianiwa ..	133	93·166
Fairfax	1004	Fairfax	102	93·143
Otahuti	331	Otahuti	127	93·120
Kennington	205	Kennington ..	467	93·104
Stirling	292	Stirling	427	93·101
Ryal Bush	477	Ryal Bush ..	307	93·091
Kaitangata	1648	Kaitangata ..	118	93·087
Morton Mains	1604	Morton Mains ..	305	93·066
Woodend	1586	Woodend	91	93·059
Maungatua	1708	Maungatua ..	69	93·050
Paretai	271	Paretai	314	93·042
Tisbury	701	Tisbury	187	93·039
Grove Bush	1882	Grove Bush ..	58	93·014

—*Dairy Division.*

CERTIFICATION OF SEED POTATOES.

CROPS PASSED TUBER INSPECTION DURING AUGUST, 1932.

Auckländer Short-top (N.Z. Sutton's Supreme.)

Crump, F., Springston.
Poulton, A. D., R.M.D., West Eyreton. (Line A.)
Roper, R. S., R.M D., Halkett.
Marshall, D., R.M.D., Leeston.
Poulton, A. D., R.M.D., West Eyreton. (Line B.)
Pirie, J., Kingsdown, Timaru.
King, W. H., Rosewill, Timaru.
Robinson, R. G., Box 4, Papanui.
Wolff, R. G., R.M.D., Horrelville.
Haines, C., 108 Waimak Road, Harewood.
Warren, J., 149 Russley Road, Fendalton. (Line A.)
Needham, M. R., North Road, Kaiapoi. (Line A.)

Dakota.

Cross, H. E., Sandy Knolls. (Line A.)
Tweedy, S., R.M.D., Dunsandel.
Walker, C. E., R.M.D., West Melton.

Aucklander Tall-top.

Cross, H. E., Sandy Knolls. (Line B.)
Brown, H. M., 114 Withells Road, Riccarton.
Doak, J. H., Barrhill, via Rakaia.

Arran Chief.

Knowler, H., Te Wae Wae, Southland.
Saunders, E. E., Studholme Junction.

Arran Chief—continued.

Teschner, C. A., Chatton Road, Gore.
Knowler, C. E., Happy Valley, Tuatapere.
Bell, J. F., Stirling.
Kirkpatrick, W. T., Airedale R.D., Oamaru.

King Edward.

Milburn, M., Wright's Bush, Invercargill.
Burgess, D., West Plains.
King, W. S., The Bend, Winton.
Caulfield, J. T., Rakahauka R.D., Glencoe, Invercargill.
King, L. A., Rakahauka R.D., Glencoe, Invercargill.
Anderson, A., Stirling.
Knowler, H., Te Wae Wae, Southland.

Bresee's Prolific.

Butcher, D. and M., R.M.D., Broadfields.

Majestic.

Robinson, R. G., Box 4, Papanui. (Line B.)

Early Rose.

Burns, R. A. C., Mead Settlement, Rakaia.

Robin Adair.

Marshall, D., R.M.D., Leeston.

Field Marshal.

Gray, J. L., St. Andrews.

—*Fields Division.*

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

DOG WITH FOOT TROUBLE.

R. D. E., Havelock :—

One of my dogs at the beginning of January became very lame, and I found that the pads of his feet were raw, though he has no road work at all. The feet heal to a certain extent, and then apparently they irritate and he bites them raw again. Can you tell me if it is a disease and what treatment he should be receiving to effect a cure?

The Live-stock Division :—

It appears as if your dog is affected with chronic eczema of the foot. This trouble is persistent, and requires careful treatment to effect a permanent cure. The lesions heal to a certain stage, and at this stage it is necessary to apply a protective covering to the feet, and also perhaps a muzzle to prevent the dog from biting If the eczema becomes moist at this healing stage it is advisable to apply a dry dusting powder composed of equal parts of boracic powder, zinc oxide, and powdered starch. This should be applied freely, and the feet require to be bandaged and protected. On the other hand, if the affected areas are dry and scaly, an ointment composed of equal parts of boracic and zinc ointments is required. Lead lotion applied on boracic lint might also give the desired results in this form. It is necessary in all cases to keep the feet protected with a covering to prevent biting and scratching, and allow recovery to take place. The feet should be carefully examined to see whether small cysts are present between the toes, as these may be the cause of the trouble reappearing. If cysts are present they require to be opened up with a lance and their lining painted with tincture of iodine. A tonic containing from 5 to 10 minims of Fowler's solution of arsenic may be given once daily in such obstinate cases.

PRAIRIE-GRASS.

"CLAUDE," Kiwitea :—

Please give me information regarding prairie-grass I intend sowing 2 acres for cutting and carting in early spring to dairy cows. Please advise when to sow, amount, whether a nurse crop is needed, and what class of hay the grass would make later.

The Fields Division :—

Prairie-grass is of some value for producing feed from late autumn through the winter until spring. It has a shallow root-system, and is favoured by open fertile soil conditions. It is useful for mowing, but will not stand severe grazing. The hay obtainable from it is of good quality. About 60 lb. of seed to the acre should be sown. A mixture of prairie-grass with lucerne is likely to give good results. As the prairie-grass makes much of its growth in winter and early spring, and as lucerne grows chiefly in summer and autumn, the two plants do not compete directly with each other throughout. Prairie-grass is usually best sown in the autumn. A nurse crop is not recommended in establishing it.

SUPERNUMERARY TEATS ON HEIFER CALVES.

"SHORTHORN," Marohemo :—

Would you please advise some method for removing extra teats on heifer calves. It is found that at times milk develops in these, and also some are placed so as to be a nuisance for machine-milking.

The Live-stock Division :—

When calves have supernumerary teats they can be taken off with a sharp pair of scissors, and the part dressed with some tincture of iodine. The younger the animal the better the result.

SPRAYING FOR LATE BLIGHT ON POTATOES.

J.M., Oparau :—

Kindly advise me what spray to use and when to apply to prevent blight on potatoes. Would a knapsack sprayer such as one uses for ragwort be suitable for applying it ?

The Fields Division :—

There are two commonly used sprays effective for controlling late blight on potatoes—namely, Burgundy mixture and Bordeaux mixture. Burgundy mixture is made by dissolving 4 lb. of bluestone in a 40-gallon wooden cask nearly full of water. This can be done by suspending the bluestone in a bag just underneath the surface of the water, when it will gradually dissolve. This done, dissolve 5 lb. of washing-soda in a small quantity of water and add to the bluestone solution, stirring vigorously the while. Then completely fill the barrel with water. This mixture is not quite as effective as the Bordeaux, but is more easily prepared and is the favourite mixture. Bordeaux mixture is prepared in the same way as the Burgundy, except that the 4 lb. of soda is replaced by 4 lb. of quicklime. The quicklime is prepared by adding a little water at a time very gradually at first, so that it forms a thick paste, then a thin paste, and then a fairly thick suspension solution. This is next added to the bluestone solution as in the case of the soda, stirring vigorously. The use of this mixture has been abandoned by many because pure unreverted quicklime has proved difficult to obtain. The spray should be used soon after the mixture is made. It should be applied first when the plants are about 6 in. high, then every fortnight or ten days till the crop is nearly mature. A knapsack sprayer would be quite suitable.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 14th July to 8th September, 1932, include the following of agricultural interest :—

No. 66431 : Manure-distributor ; J. Vorbach. No. 68787 : Milking-machine ; J. E. Haywood. No. 68820 : Milking-machine ; MacEwan's Machinery, Ltd. No. 66756 : Butter-box ; F. O. Viggers. No. 67306 : Weed-killing solution ; W. H. Bickerton. No. 67491 : Hay-collecting ; T. A. Tilt, T. A. Tilt, jun., and W. H. Tilt. No. 67537 : Pulsation control for milking-machines ; C. A. Davis and F. A. Stempa. No. 67697 : Lime and manure distributor ; A. W. Cargill. No. 68262 : Milking-machine pulsator ; F. C. Penfold. No. 68784 : Plough-share ; T. Redding and T. Mitchell. No. 68785 : Cradle for wire-banding cheese-crates ; D. A. Dunn. No. 66736 : Drying and preparing rennet casein ; N.Z. Co-operative Dairy Co., Ltd. No. 67308 : Hay-knife ; J. Irving. No. 67327 : Beehives ; O. Smith. No. 67563 : Tine harrow ; A. J. Bond. No. 67564 : Harrow unit ; A. J. Bond. No. 67435 : Milking-machine ; H. H. Johnson. No. 67685 : Harrow ; A. C. Sutherland. No. 67926 : Tine harrow ; J. W. Neate and C. G. McTaggart. No. 69027 : Sizing and grading fruit ; J. S. Tuckfield.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

Response to Potash on Grassland.—The Instructor in Agriculture, New Plymouth, reports : "The response to potash in North Taranaki is positive over a larger area than was at one time thought. We have yet to determine whether the response is an economic one, although the outstanding differences in some instances rather point to the results being payable."

Certified Rye-grass Pastures in Wairarapa.—The Fields Instructor at Masterton reported that after the rains last February areas sown down with certified rye-grass showed greater recovery from drought than pastures sown with ordinary commercial seed, and during the later dry spell held their growth better. This point was most outstanding and was remarked on by many farmers.

The New Zealand

Journal of Agriculture.

VOL. 45. WELLINGTON, 20TH OCTOBER, 1932. No. 4.

INCREASE-SEED GROWING OF CERTIFIED PERENNIAL RYE-GRASS.

MOTHER SEED AND ITS PROGENY COMPARED.

E. BRUCE LEVY, Agrostologist, and STEPHEN H. SAXBY, Assistant in Agrostology, Plant Research Station, Department of Agriculture, Palmerston North.

IT has now been amply demonstrated throughout this country, and there is also accumulating evidence from Australia and elsewhere, that New Zealand certified perennial rye-grass is an excellent type, ideally suited for permanent pasture wherever the soil and climatic conditions make such pasture at all possible. Reports from Great Britain, conservative in the extreme, go to show that the New Zealand certified seed is better than the British commercial. Our trials in the Dominion, also compared over a period of four years, now definitely go to show that the New Zealand certified perennial rye-grass as a type is superior to any type yet tested from any country in the world, including the British indigenous rye-grass harvested and selected from the old pastures of Kent.

Strain and pedigree is rapidly becoming a feature of the herbage-seed trade of the world. One has only to glance through the catalogues of the leading overseas seed firms to realize that the trade is already catering for a growing demand from overseas farmers for authentic strains of pasture plants. The hallmark put upon the New Zealand seeds by the application of certification enables seed houses the world over to handle the New Zealand material with confidence; and we predict from such firms an early demand for New Zealand certified seed. Within New Zealand itself the demand for certified perennial rye-grass is rapidly increasing, and the ready disposal of last season's harvest of 80,000 bushels of machine-dressed certified seed at a high price per bushel, and in a slump period, indicates that farmers require and are prepared to pay for the guarantee of type that certification affords.

The New Zealand output of so-called perennial rye-grass for the last four years is approximately 500,000 bushels per year, or roughly six times the amount of certified true perennial rye-grass produced last year. We are of the opinion that it is only a matter of time for the superiority of the certified seed to become more widely known,

and for the price to fall to nearer the normal price of perennial rye-grass seed, when the output of certified seed must approach the half-million bushel mark in order to meet the internal demand alone.

In view, therefore, of the large internal demand and the overseas demand that is already arising, it becomes imperative to increase greatly the area sown in New Zealand for seed-production purposes. Hawke's Bay and Poverty Bay themselves can increase considerably the area shut up for seed, but these districts will never be in a position to supply sufficient seed to cater for the growing demand. Last season approximately 58,000 bushels of machine-dressed certified seed were produced in these two districts, and this represents considerably more than their total annual production for the last few years. The question of producing certified perennial rye-grass in good seed-growing districts outside Hawke's Bay and Poverty Bay thus demands attention, and the experience of the last two years has definitely shown that the Hawke's Bay and Poverty Bay type can be successfully increase grown in any district in New Zealand where the climate is suitable for true perennial rye-grass seed production.

Hawke's Bay and Poverty Bay in this scheme for increase-seed growing under certification can be regarded as the mother-seed producing areas, and when this project is viewed nationally there is everything to commend such procedure. Those old permanent pastures of Hawke's Bay and Poverty Bay should be viewed as a national heritage; there should be no idea of parochial jealousy, because nature has decreed that the one district is more favourably suited for a specific purpose than another, and no human opinion can alter this fact. There is no question that the South Island is naturally more adapted for annual and short-rotation farming than the North Island; the more rigorous winters alone make supplementary cropping an essential feature. The demand for early spring feed, and for crops that will rapidly fatten lambs in weather not propitious for high grassland production later in the season makes it imperative that special crops be grown, and this means that a good deal of the farm is annually under the plough. Those drier areas of the South Island, such as the Canterbury Plains, North Otago, Central Otago, and Marlborough, particularly, have ideal seed-production climates provided there is sufficient moisture to grow the crops to maturity. Ploughing and cultivation prior to sowing gives depth and activates the soil; it allows easy penetration of what rains fall, and conserves this water-supply so that the sown crop on cultivated land in nine years out of ten gets ideal conditions to grow and mature a good seed crop. In the second, third, and subsequent years short-rotation lands are not usually capable of producing good crops; the ground has hardened, water penetration is more difficult, cracking of the ground in dry weather, &c., all militate against high-production crops from old grassland. Hence it will be only in the more favoured areas of the South Island that old pasture seed-production can compete with old pasture seed-production in the North Island under its more plentiful rainfall and milder climate.

For these reasons we feel that the national seed-growing campaign that should be launched is for growers in the South Island to trade freely with the North Island in matters of old pasture mother seed, and for the South Island to once-grow this on its short-rotation country to supply the bulk of seed for export and for the permanent grazing

pastures of the Dominion as a whole. In this once-growing project the greatest crop will be secured from the first harvest, and crops between 30 to 50 bushels of machine-dressed seed per acre may in normal years be expected. The question that at once comes to the mind of the farmer and seed-merchant is whether this maiden or first-harvest crop is as good as that from later crops, and whether it is a sound agronomic practice from a pasture-formation point of view to harvest seed from a one-year-old pasture.

The question of seed-growing as a business must to some extent be dissociated from the making of the ideal pasture sward. True perennial rye-grass really is more ideally constituted a grazing plant rather than a seed-producing plant, and it will not stand cutting for seed year after year. The best farmers in Hawke's Bay, for example, will not cut the same paddock two years in succession for seed, and where possible three to four, and even five, years elapse before a seeded paddock is again shut up for seed. Where seed production is practised from the same area year after year vegetative tiller shoots become fewer and fewer, the plants weaken, and the sward opens up. This opening-up of the sward, due to the reduction in number of tillers and vigour of these, affords opportunity for annual grasses and clovers to establish.* In Hawke's Bay paddocks that were once good rye-grass pastures may run to a crop dominantly goose-grass or burr clover after the third successive seed crop has been taken from any one area. Cutting a seed crop of rye-grass, therefore, at one year old undoubtedly weakens the sward, as does also a crop of seed at any stage in the life of the pasture. In a seed-growing business, however, this is inevitable, and the grower has to be prepared to sacrifice a certain amount as far as the pasture is concerned in the pursuance of his business.

The bulk seed-grower, provided always there is a source of mother-seed supply available, need not concern himself so much with the production of an ideal sward, and even though the pasture may give out after three years it is better in our opinion to make sure of payable seed crops early in the pasture development, rather than wait until the pasture ages, because of any idea farmers may have that the later crops will be of a better type than the earlier ones. Provided the mother seed is of a good type and up to the standard of the Department's certified mother seed, then there can be little if any fear that the early crops will be different from the later crops. As a matter of fact, given good growth and harvest conditions, from our studies to date the chances are that the first crop produced in the South Island or elsewhere will more closely resemble the parent than subsequent crops from that same area.

There is, however, one big danger in maiden-seed production ; and this lies in harvesting a seed crop from that area within six months of sowing down. Thus a crop sown in the spring should not be cut for seed in the following autumn. This in the South Island is scarcely practicable, but in the North Island it is possible to spring-sow and cut a small seed-crop in the following January or February. Our experience at Palmerston North goes to show that of a crop sown out

* We are definitely of opinion, however, that the possibilities of manurial top-dressing to promote good vigorous aftermath growth have not been fully exploited in New Zealand in connection with seed production from the same area for two or more consecutive seasons.

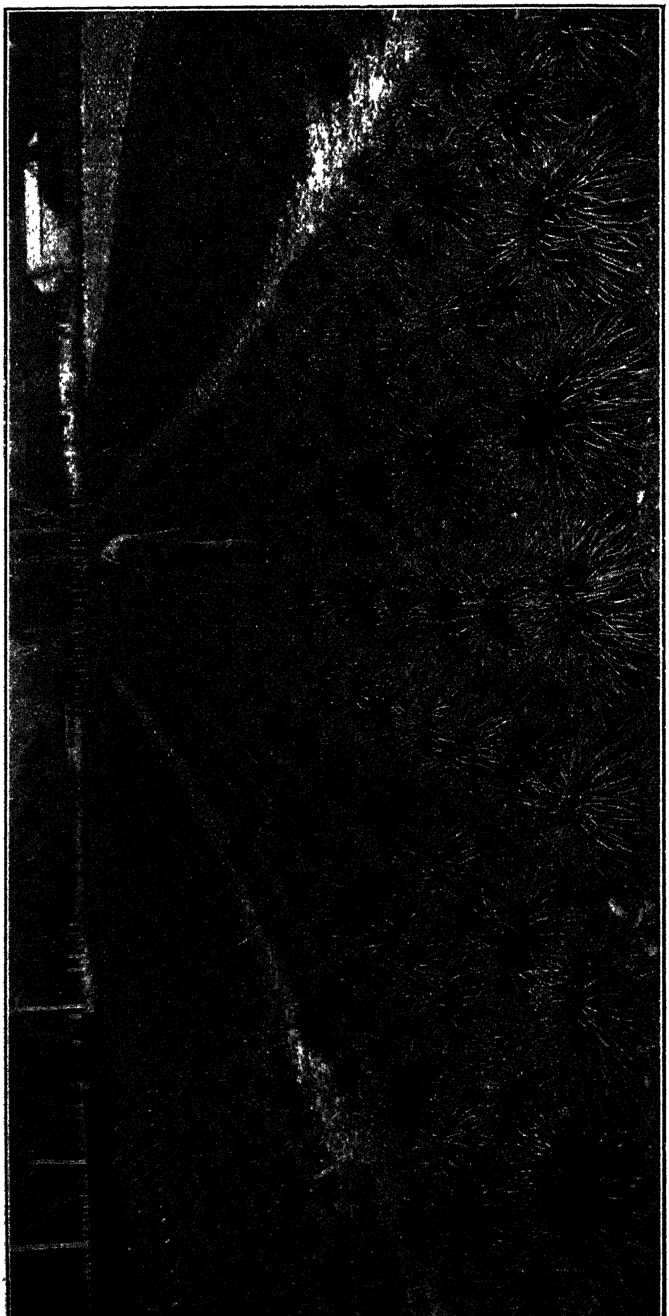


FIG. 1. GENERAL VIEW OF SINGLE-PLANT AREA AT PLANT RESEARCH STATION WHERE A COMPARATIVE STUDY OF CERTIFIED PERENNIAL RYE-GRASS MOTHER SEED AND ITS FIRST-HARVEST PROGENY HAS BEEN MADE.

In these experiments blocks of 100 mother-seed plants alternate with blocks of 100 first-harvest progeny, and in a general glance over the area no perceptible difference between the two lots could be observed. Some broadcast trials are seen on the extreme left.

[*Photo by E. Bruce Levy.*

in the spring only a proportion of plants will produce a seed crop by the following February, six months after. Those plants that produce a full crop of seed-heads within six months of sowing down are of a poor type, and if such a crop were harvested for seed the whole of the product would tend to be of an undesirable type. Given ten months or a full year growing period, however, then all plants in the sowing will flower and seed, and according to the type of the mother seed sown so will be the type of the offspring. Figs. 6 and 8 show clearly these two types of plants, and it will be obvious that were a seed crop produced in six months from sowing down and that resultant crop sown down and again cut for seed, and this repeated two or three times, the original type would very largely be lost, the line coming to consist entirely of free-flowering, early-maturing annual types of plants. Certified first-harvest seed is produced from crops sown out either in the previous autumn or after fourteen to fifteen months have elapsed from the spring sowing. This is a point growers of seed for certification should keep clearly in mind.

EVIDENCE OF SINGLE-PLANT TRIALS.

The single-plant analysis is the best means of making a critical examination of a line from the point of view of type variation, either between lots of varying origin or lots of the same origin. In order to study the effect of once-growing the Hawke's Bay and Poverty Bay type of perennial rye-grass outside these districts, four thousand single plants were put out at the Plant Research Station. These plants were representative of eighteen mother-seed lines and their first-harvest progeny grown in twenty-two different areas—three in Hawke's Bay itself, two in the Sandon district, two in Marlborough, four in North Canterbury, three in South Canterbury, and eight in Otago and Southland.

Comparison of mother-seed and first-harvest seed lines with regard to Italian rye-grass and slightly awned types of plant present.—In all the mother-seed lines tested—1,800 single plants—not one plant of Italian rye-grass or slightly awned type of plant was noted. In the total of 2,200 first-harvest plants eight strongly or slightly awned plants were found. These were contained in two lines from Marlborough, three from Otago, and one from North Canterbury. This would indicate that there is a slight deterioration due to contamination with Italian and the false perennial rye-grass type as a result of growing the mother seed on land that originally produced a crop of Italian or false perennial. The proportion of these, however, is extremely small, being approximately one-third of 1 per cent., or roundly three plants per thousand. Careful selection and preparation of the ground and subsequent field inspection at harvest time afford a sufficient guarantee that field contamination with Italian and false perennial types is for all practical purposes negligible in once-growing mother seed outside its district of origin, and should cause no concern whatsoever to the farmer laying down permanent pasture.

Comparison of mother-seed and first-harvest seed lines with regard to proportion of undesirable, open-crowned, and early-maturing types.—From single-plant analyses made of some hundreds of mother-seed lines from Hawke's Bay and Poverty Bay it has been shown that no

line is of a uniform type. Erect or semi-erect, dense, tussocky types of plants predominate, and it would appear that the superiority of the New Zealand certified strain is due to this erect and semi-erect, dense, tussocky type. In all lines, however, there is a varying percentage of early-maturing, squat, flat, open-crowned types, which must be regarded as inferior types of plants for the purpose of high-production permanent pasture at least, bearing in mind that the predominating plants in the good false perennial lots and in low-production true perennial lots are essentially of this type.

These types are depicted fairly satisfactorily in Figs. 2 to 5. Table 1 serves to show the number of these poorer types of plants occurring in the mother-seed lines from Hawke's Bay and in their first-harvest progeny The figures serve to indicate that from a type point of view—regarding the erect, dense, slow-maturing type as the more desirable—there is an approximate 2 per cent. deterioration in once-growing the original mother seed and in harvesting that crop the first year down. Here again, from the point of view of the permanent pasture, the farmer can with perfect safety place full reliance on the first harvest certified permanent pasture seed as representing a high-grade article for the sowing-down of his permanent grassland.

Table 1.—Relative Numbers of Undesirable, Squat, Open-crowned, Early-maturing Types in Original Mother-seed Lines and First-harvest Progeny from those Lines.

In Mother Seed.	In First-harvest Progeny.	District where grown.
Per Cent.	Per Cent.	
16	20	Hawke's Bay.
14	15	Sandon.
12	16	Marlborough.
12	14	North Canterbury.
12	16	South Canterbury.
16	16	Otago and Southland.
13·6	16·1	(Average).

Comparison of mother-seed and first-harvest seed lines with regard to rapidity and extent of flowering, five and six months approximately after sowing down.—As before indicated, rate and extent of flowering is a vital point to be considered in first-harvest seed production. There is no doubt that the poorer types mature earlier than the better ones, and actually it would seem sound to gauge type and persistency in relation to speed of maturity. The seeds in the present study were sown in boxes on 30th July, 1931, and were transferred to their present position as spaced plants 2 ft. apart each way on following 21st October. Table 2 shows the relative number of plants tending to run to maturity five to six months after the seed was sown. Mother-seed lines are contrasted with the first-harvest progeny, and again it will be obvious that there is a slightly greater percentage of early-maturing types in the first-harvest lots compared with the original mother seed, which again serves to emphasize the possibility of rapid deterioration when first-harvest seed is cut and resown year after year. The major lesson here, however, is the fact that no crop of seed should be taken from a spring-sown crop in the autumn following that sowing, for even if the crop is left until late in February it will be noted that 30 to 40 per cent.

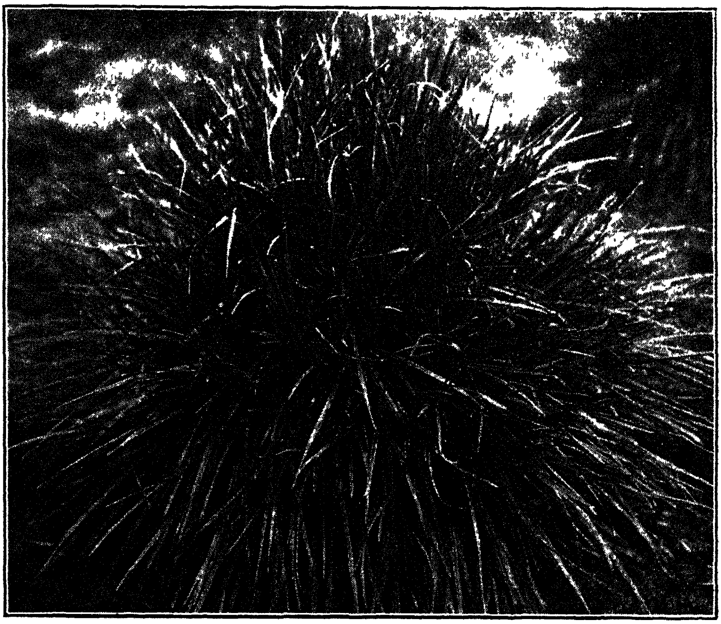


FIG. 2. GROWTH-FORM IN CERTIFIED RYE-GRASS: THE ERECT, DENSE, TUSSOCKY, MATURED PLANT LARGELY RESPONSIBLE FOR THE MARKED SUPERIORITY OF THE NEW ZEALAND CERTIFIED TYPE.

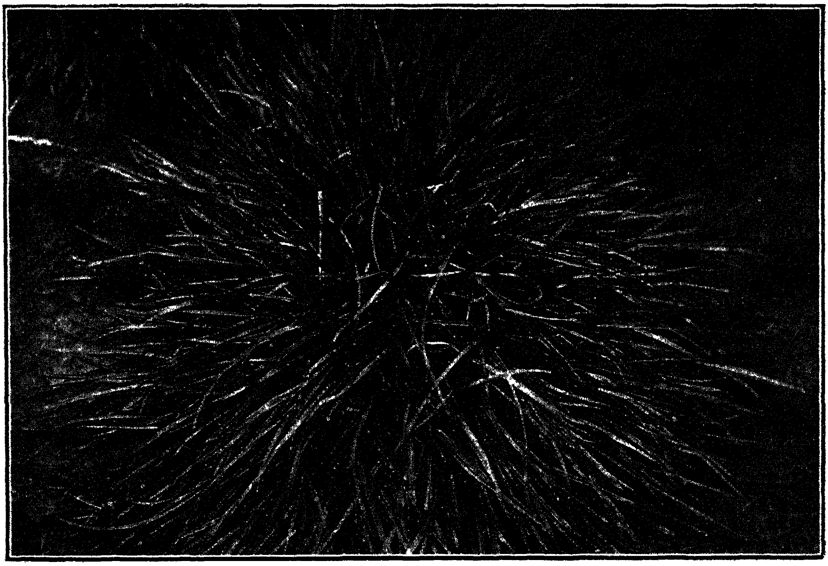


FIG. 3. THE SEMI-ERECT, DENSE, MUCH-TILLERED HIGH-PRODUCING TYPE.

[*Photos by E. Bruce Levy.*

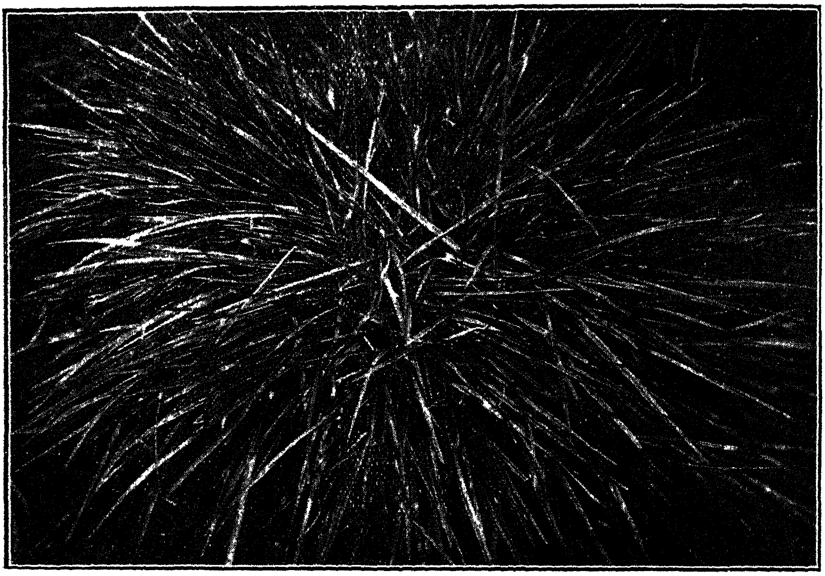


FIG. 4. THE SQUAT, PROSTRATE, OPEN-CROWNED, MODERATELY HIGH-PRODUCING TYPE.

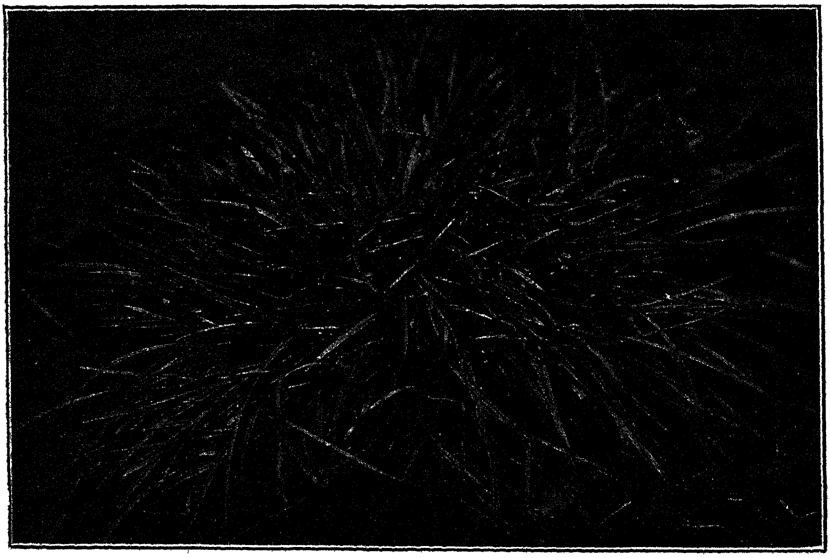


FIG. 5. THE SQUAT, PROSTRATE, FLAT-CROWNED, LOW-PRODUCING, AND SLOW-RECOVERY TYPE.

[*Photos by E. Bruce Levy.*

of the plants have not flowered by this date, and almost invariably such non-flowering types are the most desirable in the line.

In the figures given in the table three heads per plant constitute for record purposes a plant in flower, and the figures as set out are really high as indicating the extent of the flowering that actually occurred. Possibly not more than 20 per cent. of plants produced a full crop of flower heads, and these were essentially all of an undesirable early-maturing short-lived nature.

Table 2.—Relative Speed and Extent of Flowering in Spring-sown Mother-seed Lines and the First-harvest Progeny of those Lines. (Date seed sown, 30/7/31 . date planted out, 21/10/31.)

Percentage of Plants flowering 13/1/32.		Percentage of Plants flowering 17/2/32.		District where grown.
In Mother-seed Lines.	In First-harvest Progeny.	In Mother Seed.	In First-harvest Progeny.	
43	46	70	70	Hawke's Bay.
44	55	69	72	Sandon.
31	43	55	68	Marlborough.
51	57	75	75	North Canterbury.
45	48	72	69	South Canterbury.
47	50	70	73	Southland and Otago.
43·5	49·8	68·5	71·1	(Average).

Comparison of mother-seed and first-harvest seed lines with regard to rust susceptibility.—Rust susceptibility in rye-grass may be regarded to some extent as an index of type, the weaker-constitutioned, false perennial types being more susceptible to rust—in the North Island at least—than the vigorous true perennial certified type. An analysis of single plants from the rust susceptibility point of view, therefore, gives a good indication whether there has been any appreciable weakening in the Hawke's Bay type by once-growing the mother seed and in harvesting a first-harvest progeny crop. Table 3 puts the position fairly clearly, and indicates that there has been scarcely any perceptible change in susceptibility by once-growing outside the district of origin.

Table 3.—Relative Rust Susceptibility of Mother-seed Lines compared with the First-harvest Progeny of those Lines.

Mother-seed Lines.	First-harvest Progeny.	District where grown.
Index Figure.	Index Figure.	
100	101	Hawke's Bay.
100	100	Sandon.
100	103	Marlborough.
100	105	North Canterbury.
100	103	South Canterbury.
100	97	Otago and Southland.

Comparison of growth-forms within the mother-seed lines compared with the first-harvest progeny.—There seems to be little doubt that the marked superiority of the Hawke's Bay and Poverty Bay perennial

FIG. 6. CERTIFIED RYE-GRASS FIRST-HARVEST PROGENY SINGLE PLANTS FROM LINE GROWN IN SOUTHLAND.

Photo taken on 3/2/32, when plants were six months old. Note, generally, early-maturing type of plants in full flower, while the good leaf-producers are showing an absence of flower-heads. Compare with Fig. 7.

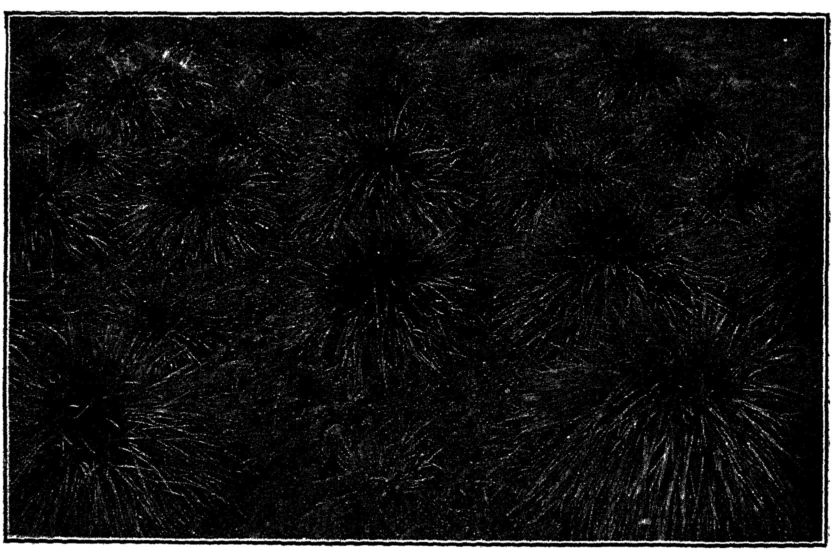


FIG. 7. THE SAME PLOT AS IN FIG. 6, PHOTOGRAPHED ON 25/5/32.

Showing generally the recovery after cutting, and specifically the non-recovery of the early-maturing free-flowering six-months-old plants. Compare front plant of middle row and second plant of row on left with the same plants in Fig. 6.

[*Photos by E. Bruce Levy.*

rye-grass over all other perennial rye-grass lots yet tested is due to the presence in the Hawke's Bay and Poverty Bay type of an erect, dense, tussocky type of plant (Fig. 2). The prevalence of these erect and semi-erect types of plants may be taken as some index of the quality of the line and whether or not there has been marked deterioration by once-growing. Table 4 shows that in the markedly erect type there has been in the aggregate a falling-away in numbers within the first-harvest lots of the erect and semi-erect type compared with the parent mother-seed lots.

Table 4.—Relative Percentages of the Different Growth-forms within Mother-seed Lots and the First-harvest Progeny.

Class	Growth-form				
	Erect.	Semi-erect.	Semi-prostrate.	Prostrate.	Dead.
Mother-seed lines ..	20	28	27	22	3
First-harvest progeny	17	27	27	26	3

Comparison of growth-forms within the various lots of mother-seed and first-harvest lots showing relatively different germinability.—There is every possibility that the various growth-forms in rye-grass are differentially susceptible to injury when a crop is grown under adverse climatic conditions. Certainly the rye-grass crop is sensitive to the weather conditions ruling irrespective of the district where grown. Thus in Hawke's Bay and Sandon, for example, in a relatively wet year the germination of the crop is universally low and in a dry year it is universally high. The question arises whether any one growth-form within those lines is more susceptible to injury than another, or whether all forms suffer alike. Table 5 gives some indication that where a rye-grass crop is adversely affected through bad climatic and bad harvesting conditions, there is a reduction in the erect, dense, tussocky type, and an increase in the squat, open-crowned, prostrate type. If this is so, high germinability is important in a line, as this would indicate preservation of the type more definitely than where a crop had suffered through adverse harvesting conditions.

Table 5.—Relative Percentages of Growth-forms within Lines of High and Low Germinability.

Lines.	Growth-form.				
	Erect.	Semi-erect.	Semi-prostrate.	Prostrate.	Dead.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
High-germinating ..	19	30	28	23	2
Low-germinating ..	16	27	25	30	3

Comparison of persistency within the mother-seed lines compared with their first-harvest progeny and with typical bad false-perennial lots.—High persistency, coupled with high production, is a marked characteristic of New Zealand certified perennial rye-grass, and from the experiments to date, both in the single plant and in broadcast swards, the

FIG. 8. CERTIFIED RYE-GRASS FIRST-HARVEST PROGENY SINGLE PLANTS FROM LINE GROWN IN NORTH CANTERBURY.

Photo taken on 3/2/32, when plants were six months old. Here, as in Fig. 6, differential flowering can be observed.

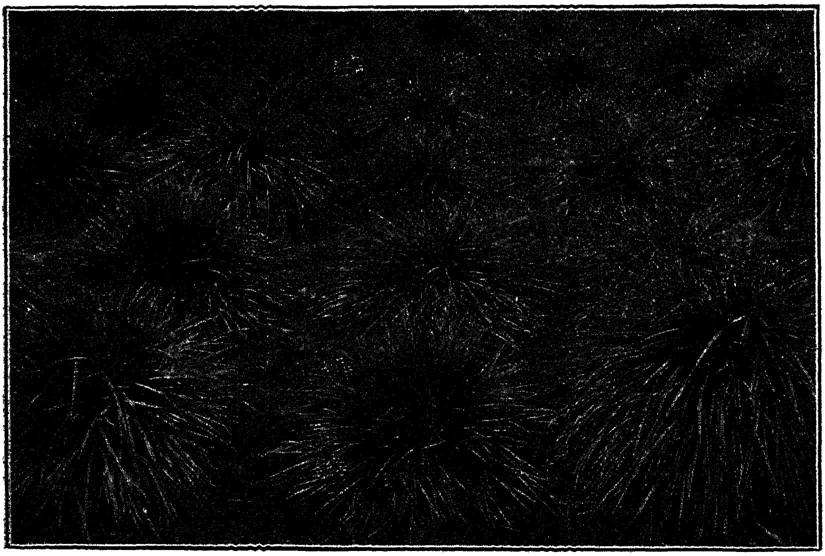


FIG. 9. THE SAME PLOT AS IN FIG. 8, PHOTOGRAPHED ON 25/5/32.

Showing generally the recovery after cutting, and here again the early flowering type (compare front plants middle row in this and Fig. 8) has made relatively poorer recovery than the non-early-flowering types on either side.

[*Photos by E. Bruce Levy.*

first-harvest progeny is equal in persistency to the mother seed itself. In Tables 4 and 5 it will be noted that the death-rate after twelve months is extremely low and virtually equal within the two lots. This is in marked contrast to typical false perennial lots, where the death-rate after twelve months may be extremely high. This is clearly exemplified in Table 6.

Table 6.—Showing relative Persistency of Mother-seed Lots and their Progeny compared with False Perennial Lots of Rye-grass. (All plots twelve months old.)

Mother Seed, Type 1.	First-harvest Progeny, Type 1.	Good False, Type 3.	Average False, Type 4.	Bad False, Type 5
3 per cent. dead	3 per cent. dead	5 per cent. dead	24 per cent. dead	58 per cent. dead.

EVIDENCE OF BROADCAST TRIALS.

The evidence of single plants would indicate that the first-harvest progeny of certified mother seed was approximately 2 per cent. poorer than the parent seed. As one would surmise, this small difference is quite indiscernible when the lots are sown side by side in broadcast trials. In this study to date a total of 171 lots of first-harvest progeny from Hawke's Bay, Poverty Bay, Sandon, Marlborough, Canterbury, Southland, and Otago have been broadcast sown alongside mother-seed lots, and after eighteen months' trial it can definitely be asserted that there is no discernible difference between the mother-seed lots and the first-harvest progeny.

For the sowing-down of permanent pasture, therefore, apart altogether from seed production, the deciding factor in buying certified rye-grass seed is largely a matter of price. One knows, of course, that the farmer who has bought old-pasture seed in the past will probably continue to buy old-pasture seed irrespective of price. The evidence put forward here is simply a statement of the facts as we see it after very comprehensive trials.

The seed-grower, if he is to take full advantage of the benefits of certification, must sow down certified mother seed, and the work of the last twelve months has fully shown the wisdom of this. A 2 per cent. deterioration in the once-growing is negligible, but if that first-harvest seed is grown again for seed the deterioration, at a conservative estimate, would double itself and in all probability keep on doubling itself, until finally one had a false perennial type typical of the average commercial rye-grass on the market to-day. This all serves to emphasize the value to New Zealand of our present mother-seed areas, and indicates definitely that if the type is to be maintained seed-growers should make frequent and regular renewals of mother-seed stocks, preferably, one would say at the moment, from Hawke's Bay and Poverty Bay areas where the certified type has been evolved, and where one has the greater guarantee that the type will remain constant. There is no guarantee at the moment that certified mother seed from Hawke's Bay or Poverty Bay sown out, say, in the South Island or in Australia will have retained all the desirable characteristics of the

FIG. 10. FIRST-HARVEST PROGENY OF CERTIFIED PERENNIAL RYE-GRASS (ON LEFT) AND NON-CERTIFIED FALSE PERENNIAL FROM SOUTH CANTERBURY (ON RIGHT).

Plots sown 16/10/31 and photographed 25/5/32, following a dry spring and summer. The false perennial rye-grass is largely replaced by volunteer white clover.

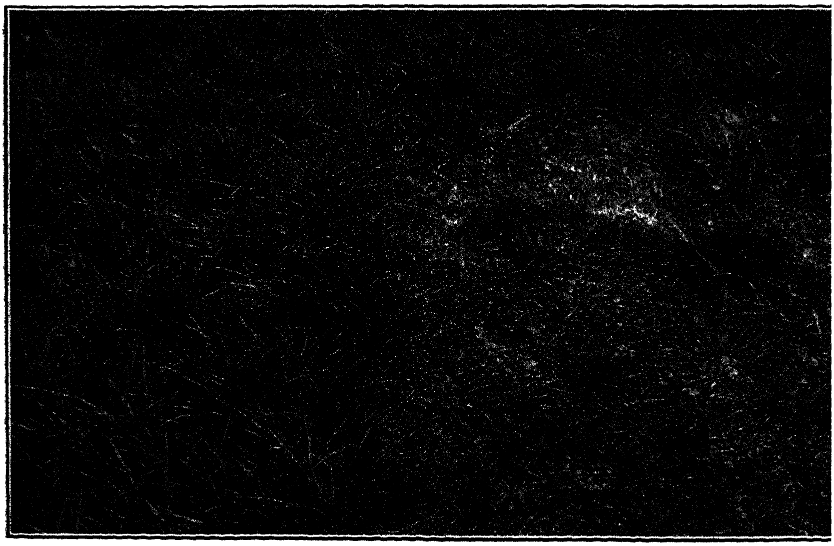


FIG. 11. FIRST-HARVEST PROGENY OF CERTIFIED RYE-GRASS (ON LEFT) AND A FALSE PERENNIAL RYE-GRASS FROM SOUTHLAND (ON RIGHT).

Plots sown 16/4/31 and photographed 20/5/32, thirteen months old. It is obvious from this and Fig. 10 that type of rye-grass is more important than age of stand from which the crop has been produced.

[*Photos by E. Bruce Levy.*

certified rye-grass in, say, ten years' time. Environment will probably play its moulding influence with the years.

We particularly wish to stress the following points :—

(1) There is a slight deterioration in the first-harvest progeny.

(2) New Zealand seed-growers, if the type is to be maintained, should regard certified-seed production as a national undertaking, and should be prepared to buy freely from those districts where the certified type has been evolved, for the purpose of renewals of reliable mother-seed stocks. This also applies to overseas growers who may wish to once-grow the New Zealand certified perennial rye-grass type.

(3) No first-harvest seed-crop should be taken from an area until it has gone through the full growing year—that is, spring-sown crops should not be harvested for seed in the following January or February, but should run until the next harvest season. Autumn-sown crops, however, may be harvested the following summer.

DAIRY-HERD TESTING IN NEW ZEALAND.

REVIEW OF THE 1931–32 SEASON.

W. M. SINGLETON, Director of Dairy Division, Wellington.

IN reviewing the past season's herd-testing work it must be kept in mind that 1931–32 was one of the most difficult periods the dairy industry of this country has yet experienced, a period of extremely low prices accompanied by climatic conditions which, on account of the abnormal dryness in many dairying districts, retarded production. A decrease in both average production and number of cows tested was anticipated, although the falling-off in membership was probably less than was generally expected. There were roughly eighty thousand more cows milked in the Dominion in 1931–32 than in 1930–31, an increase of about 5·3 per cent., while the total butterfat-production over the same period increased approximately 5 per cent. The average production of tested cows decreased by 4.18 lb. of butterfat, being 241·05 lb. for 1930–31 and 236·87 lb. for the season under review.

To briefly sum up the position relating to average production of tested cows, it would appear that four principal factors have operated against an increase. These are (1) an adverse season climatically, (2) a decreased use of fertilizers during the preceding season, (3) an increase in first calvers as the result of more cows having been brought into milk, and (4) non-culling or less culling, because of the attempt to obtain a maximum total production.

Some 259,857 cows were systematically tested last season, a falling-off of 11,547 from the preceding season. The tested cows represented approximately 16·4 per cent. of the total cows in milk. The Group test has now risen to such prominence as to account for over 90 per cent. of last season's tested cows ; cows tested under the Association own-sample system numbered 25,111 ; and 219 cows were tested by dairy companies on behalf of their suppliers. Although, therefore, there is no marked falling-off in number of tested cows, the cows in milk are increasing so rapidly as to make the relationship between total

Table 1.—Numbers of Cows tested Twice or more, and Percentages of Total Cows in Milk, classified according to Land Districts.

Land District.	1927–28.		1928–29.		1929–30.		1930–31.		1931–32.	
	Cows Tested.	Percentage of total Cows in Milk.	Cows Tested	Percentage of total Cows in Milk.	Cows Tested.	Percentage of total Cows in Milk.	Cows Tested.	Percentage of total Cows in Milk.	Cows Tested.	Percentage of total Cows in Milk.
North Auckland ..	41,067	20·2	48,713	23·3	58,113	24·5	55,283	20·9	56,091	19·6
Auckland ..	101,796	29·0	106,823	28·2	109,811	26·8	102,534	22·6	99,806	20·6
Gisborne ..	5,756	19·2	9,579	29·0	12,329	33·4	10,418	25·0	9,145	20·4
Hawke's Bay ..	4,638	10·1	8,243	17·5	8,505	17·0	8,742	16·7	4,933	9·2
Taranaki ..	23,581	11·9	30,298	15·1	31,693	15·1	32,519	14·7	31,179	13·8
Wellington ..	32,267	17·9	36,547	19·6	42,224	21·1	35,875	16·7	30,569	13·6
North Island ..	209,105	20·7	240,203	22·8	262,675	23·0	245,371	19·7	231,723	17·6
Nelson ..	656	2·5	1,241	4·8	2,128	8·0	5,732	20·9	6,637	23·7
Marlborough ..	434	3·0	2,176	14·7	3,628	23·7	3,064	19·2	2,647	16·2
Westland ..	..	..	..	..	..	..	2,380	18·8	5,030	39·6
Canterbury ..	3,280	4·6	3,524	4·9	2,816	3·8	3,244	4·3	2,344	3·0
Otago ..	769	1·5	581	1·1	2,975	5·7	3,775	7·0	4,480	7·9
Southland ..	9,886	14·7	11,869	17·4	9,509	13·7	7,838	10·9	6,996	9·4
South Island ..	15,025	6·3	19,391	8·0	21,056	8·5	26,033	10·2	28,134	10·6
Dominion ..	224,150	18·0	259,594	20·1	283,731	20·4	271,404	18·0	259,857	16·4

NOTES.—" Total Cows in Milk " is at 31st January in each year. The 1931–32 percentages are calculated on interim figures

cows and tested cows less favourable than could be desired. The peak year was reached in 1929–30, when 20·4 per cent. of the country's cows were under test, but, as will be seen, there has since been a drop of 4 per cent. in two seasons.

Despite the general financial stringency there were some eleven new groups operating last season, and obviously these helped to make the position appear more favourable, there having been a fairly substantial falling-off in some of the older established districts. The South Island again showed an increase, and it is pleasing to find the herd-testing movement so firmly established in Westland, which last year tested some 39·6 per cent. of its total cows in milk—easily the highest percentage for the Dominion. The establishment of new groups is no doubt due in no small measure to the financial assistance rendered by the Government subsidy to herd-testing. The terms relating to the distribution of the subsidy have been such that newly formed groups have received a grant up to £50 to cover the cost of outfit, and in the majority of cases this sum meets the full expenditure.

Table 1 provides a classification of tested cows according to land districts, and includes a column for percentage of cows tested. The figures relating to the 1931–32 season are based on interim returns only, but are not likely to be materially altered. Any irregularities will be corrected in next year's summary. This table affords clear evidence of the fact that, taken as a whole, herd-testing has lost ground fairly heavily.

Table 2 provides a general survey of the number and size of the various organizations. As explained in previous reviews, the term "organization" denotes any herd-testing body, whether Group, Association, or Dairy Company. Moreover, the term applies to each individual unit; for example, an organization operating ten groups is included as ten, not one. By an "effective" summary is meant that the table is compiled from individual summaries which appear sufficiently complete and reliable to justify inclusion. Notable features of this table are that, while the number of organizations has increased, there has been a marked falling-off in the number of cows per organization; in other words, the groups have been smaller.

Table 2.—Number of Cows, Herds, and Organizations represented in Effective Seasons' Summaries received. (Basis: All Cows in Milk 100 Days or over.)*

—	1929-30.	1930–31.	1931–32.
Number of organizations	282	270	278
Number of herds	7,107	6,347	5,985
Number of cows	272,554	260,469	251,441
Average number of herds per organization	25	23	22
Average number of cows per herd ..	38	41	42
Average number of cows per organization..	967	964	904

* Including both Group and Association systems, and on basis of sections or units.

Table 3 indicates the position from the point of view of the average number of cows and herds per organization. As will be seen, the number of cows per group continues to decrease. As pointed out last year, this is an undesirable trend, having an unfavourable influence on cost of operation.

Table 3.—Average Size of Associations and Groups for which Effective Seasons' Summaries on the Basis of all Cows in Milk 100 Days or over were received.

System.	Season.	Average Number of Herds per Association or Group.	Average Number of Cows per Association or Group.	Average Number of Cows per Herd.
Group ..	1927–28	28	1,250	45
	1928–29	29	1,304	44
	1929–30	28	1,288	46
	1930–31	25	1,216	47
	1931–32	24	1,166	48
Association ..	1927–28	21	414	20
	1928–29	20	401	19
	1929–30	20	363	19
	1930–31	18	333	18
	1931–32	15	270	18

Table 4 is a very comprehensive production summary, and enables a useful survey of the general position to be made. The remarkable extremes in the highest and lowest yields for herds and individuals are noteworthy. One of the good features is the pronounced increase in the average days in milk for all cows. The figures in this table are based on 5,985 herds, of which 4,772 were tested under the Group system and the remainder of 1,213 under Association own-sample test, as compared with a total of 6,347 herds (4,983 Group and 1,364 Association) for 1930–31.

Table 4.—Grand Summary of all Effective Herd-testing Results on the Basis of all Cows in Milk 100 Days or over received for the Last Two Seasons.

—	1930–31.			1931–32.		
	Number of Cows.	Days in Milk.	Butterfat-production.	Number of Cows.	Days in Milk.	Butterfat-production.
			lb.			lb.
Average for all cows	260,469	247	241·05	251,441	253	236·87
Average for all Group cows ..	234,799	250	241·50	229,606	256	238·11
Average for all Association cows	25,670	225	236·90	21,835	229	223·79
Highest Group average ..	812	277	302·73	437	265	291·27
Lowest Group average ..	326	211	152·76	539	243	185·52
Highest Association average ..	4	275	405·00	10	268	397·00
Lowest Association average ..	54	187	139·62	83	173	143·57
Highest Group herd	12	286	430·25	7	276	458·29
Lowest Group herd	26	132	77·19	39	131	56·54
Highest Association herd ..	4	258	434·06	5	329	478·99
Lowest Association herd ..	2	107	67·91	5	122	68·24
Highest Group cow	..	324	724·00	..	337	909·00
Lowest Group cow	..	100	12·00	..	130	11·00
Highest Association cow ..	..	306	714·31	..	332	598·36
Lowest Association cow ..	..	100	27·00	..	107	28·20
Average daily production of butterfat for all Group cows	..	..	0·96	..	..	0·93
Average daily production of butterfat for all Association cows	..	..	1·05	..	..	0·98

Table 5.—Average Production, according to Land Districts, of all Cows under Herd-test for which Effective Seasons' Summaries were obtained. (Basis: 100 Days or over.)

Land District.	1928–29.			1929–30.			1930–31.			1931–32.		
	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.
			lb.			lb.			lb.			lb.
North Auckland	45,735	234	222·87	55,458	245	241·15	53,158	243	218·16	54,101	253	229·56
Auckland	102,239	247	238·27	106,549	256	260·27	99,042	253	243·95	97,218	260	233·61
Gisborne	9,045	233	230·45	11,606	236	234·62	9,899	235	225·13	8,853	250	242·29
Hawke's Bay	7,705	243	249·61	8,281	221	258·06	8,324	227	219·28	4,808	253	246·71
Taranaki	28,515	249	259·76	30,366	254	271·59	31,633	259	268·40	29,960	257	256·41
Wellington	34,524	243	257·93	40,343	242	246·80	34,152	248	252·29	29,215	244	226·03
North Island ..	227,763	243	240·92	252,603	249	254·03	236,208	249	240·97	224,155	256	235·32
Nelson	936	203	237·00	1,976	225	255·15	5,464	229	244·36	6,447	236	250·16
Marlborough	1,956	217	244·84	3,417	224	250·76	2,913	237	247·20	2,567	239	247·67
Westland	..	..	..	..	..	..	2,321	229	234·54	4,902	232	241·59
Canterbury	3,081	218	237·67	2,506	206	237·65	2,627	212	220·57	2,155	219	220·67
Otago	552	219	253·99	2,790	227	244·41	3,535	228	237·94	4,319	236	252·03
Southland	11,523	225	231·89	9,262	227	249·92	7,401	231	249·47	6,896	237	261·26
South Island ..	18,048	222	235·22	19,951	224	248·27	24,261	229	241·81	27,286	234	249·63
Dominion	245,811	242	240·50	272,554	247	253·61	260,469	247	241·05	251,441	253	236·87

In Table 5 the butterfat-production of tested cows is classified according to land districts. All districts in the South Island showed an increase, while average production for the South Island as a whole rose by 7·82 lb. of butterfat. The position was doubtless assisted by the fact that Otago and Southland, and in a lesser degree Westland, experienced a more normal season climatically.

Subsidies and General.

Herd-testing received considerable assistance for the past season by way of subsidies. The New Zealand Dairy Produce Board's grant of £6,000 has already been distributed, and it is expected that the Government subsidy of approximately £7,700 will be allocated at an early date. The final result will be that newly-formed groups will in most cases have been fully reimbursed for expenditure on purchase of plant, and that herd-owners will have received a total of around 11d. per cow if testing under the Group system or half that sum if testing under the Association own-sample test. In addition, many of the larger organizations made substantial reductions in fees last year, and have probably reached the minimum commensurate with effective operation.

The sub-committee of the New Zealand Herd-testing Central Executive met on some half-dozen occasions during the season, and has done valuable work in the direction of assisting to place the movement on a sounder and more uniform footing. The Federation Supervisor of Herd-testing, Mr. C. M. Hume, has had a busy year, having paid personal visits to practically every organization in the Dominion.

Thanks are again due to officers in charge of herd-testing organizations for supply of the data necessary for compilation of the foregoing summary. Returns for nearly 97 per cent. of the cows tested twice or more were received in sufficiently complete and reliable form for inclusion, and in the great majority of cases summaries were submitted promptly.

Co-operation by the Wheat Research Institute.—The second annual report of the Wheat Research Institute refers to this aspect of the work as follows: "Co-operation with the Department of Agriculture has been maintained and extended in various directions, and the Institute acknowledges the great assistance it has received from the Director-General and staff of that Department. An important step forward was made when the Department moved its seed-growing station to fields belonging to Lincoln College and immediately contiguous to that occupied by the Institute. All the stages of seed-wheat production are now carried out on one farm, although by three institutions. This Institute imports or produces new varieties and tests their suitability for commercial utilization When they are proved useful they are handed over to the Department of Agriculture, which raises of each a stock of pure seed sufficient to sow a field—and maintains this supply. This pure seed is then handed on to Lincoln College, which grows it on a commercial scale, threshes and dresses it on its own machines, and subsequently arranges for its distribution in a pure state to the farmers of the country. Besides this the Department of Agriculture has in consultation with the Institute conducted wheat-variety trials in all parts of the wheat-growing area, and the Institute has investigated the plant response to manures for the Department and seed-sowing methods for the College. The College has, in its turn, given every facility for our work in accommodation, equipment, and labour.

POTATO VARIETY TRIALS CONDUCTED BY THE FIELDS DIVISION.

SEASONS 1930–31 AND 1931–32.

THIS series of potato variety trials was commenced by the Fields Division in the season 1930–31, when thirty varieties were under trial at sixteen different centres. The results were published in the *Journal* for September, 1931.

During the 1931–32 season thirteen trials were again conducted on the following farms: Ruakura Farm of Instruction, Hamilton; N. Hughes, Maxwell, Wanganui; M. Voss, Karere, Manawatu; High School, Rangiora, Canterbury; St. Andrew's College, Papanui, Canterbury; L. T. Wright, Annat, Canterbury; Boys' High School, Timaru; W. T. Sings, Awamoa, North Otago; G. H. Craig, Mosgiel, Otago; J. F. Bell, Stirling, Otago; Gore Experimental Area, Southland; C. H. Wilson, Lorneville, Southland; C. E. Knowler, Tuatapere, Southland.

Of the varieties under trial in the previous season six were discarded, while seven additional varieties were included. In the case of those varieties under trial for a second season forty sets were reserved from the previous crop and replanted, while of the new varieties ten tubers from the Government Pure Seed Station, Lincoln, were included at each centre.

In order to avoid as far as possible the effect of varying degrees of virus infection in the different varieties, the original material sent out for the first season's trial was selected from lines showing the least percentage of virus. Unfortunately, however, the percentage of virus was even then relatively high in a few varieties, and in the second season considerable infection showed due to the spread of disease during the first season. This was particularly so in the case of the varieties Arran Chief, Iron Duke, and Bresee's Prolific, while Early Regent bolter also showed a fair amount of virus in the second season's trials. Too much reliance therefore should not be placed on the unfavourable report on these. A fresh supply of healthy seed will be required if these trials are to be continued.

There has been close agreement between the results obtained for the two seasons, and the present report is in the nature of a summary of both.

JUDGING FACTORS EXPLAINED.

Varieties have been judged on the following points, and the marks given are the average of the two season's results:—

(1) Cropping power: This is an estimate of the yield computed by adding to the yield of table-size tubers half that of seed-size tubers. The figure given is in tons per acre, and is the average over the whole of the trials.

(2) Range of adaptability: In this column an attempt has been made to convey some idea of the general performance of each variety in the districts concerned. It will be noted that in general the figure conforms to the cropping power.

(3) Commercial possibilities: This figure is the average of marks allotted in the trials for the relative value of each variety from a commercial viewpoint.

(4) Maturity: While the period from planting to ripening has not been recorded with any great accuracy, it is interesting to note that the relative order of maturity shows no great variation in the two seasons' results. One point, however, stands out. Whereas the average time to reach maturity for first earlies in 1930–31 was 112 days, in 1931–32 it was 139 days. There is the same variation, though less marked, in the later-maturing varieties. As a result the varieties included in the trial for the first time this season appear to be wrongly grouped in the tables. They have been so placed, however, following comparisons with the figures for other varieties in the 1931–32 season.

(5) Blight resistance: Except in two instances, the figures for blight resistance agree very closely in the two seasons. It appears therefore as though more reliance can be placed on these figures than was originally thought. Seasonal conditions have such an effect, however, that comparisons can be made only between those varieties maturing at about the same stage.

No attempt has been made to record cooking qualities in the second season, but some notes are given on the cooking qualities of the new varieties. Those of the other varieties may be found in the records of the first season's trials.

Grouping of Varieties.

Varieties are grouped into four classes, and it is interesting to record that in no case has it been found necessary to change the grouping which was made on the 1930–31 results. It should be remembered that while comparisons in cropping power and maturity may be made between varieties of one class and those of another, factors such as range of adaptability, commercial possibilities, and blight resistance are so influenced by date of maturity as to limit comparisons to those varieties in one class only. Results are presented in Tables 1 to 4.

Table 1.—Main-crop Varieties (Average of Two Seasons, 1930–31 and 1931–32).

Variety.	Cropping Power per Acre.	Range of Adaptability —0–10.	Commercial Possibilities— 0–10.	Maturity.	Blight Resistance— 0–10.
	Tons.			Days.	
Kerr's Pink.. ..	9·7	9	6½	170	8
Dakota	9·2	8½	7½	174	4½
Up-to-Date	9·2	8	9	167	3½
Aucklander Tall-top ..	8·9	8	8	172	9
Field Marshal ..	8·9	7½	9	164	7
Endurance	7·8	5½	6	164	3½
Northern Star ..	7·5	5	5½	170	7½
Arran Consul ..	7·4	5½	7½	165	8
Iron Duke* ..	7·1	4	7	175	9
Arran Chief* ..	6·2	2	7½	167	5
Average yield ..	8·2	..	..	..	..

* Results misleading on account of virus disease.

NOTE.—For allocation of points for Range of Adaptability, &c., in this and subsequent tables, see preceding section headed "Judging Factors explained."

Comments on Varieties listed in Table 1.

Kerr's Pink.—This variety has again done very well. The pink colour of the skin has caused marks to be deducted for "commercial possibilities."

Dakota has done well in each season. This is another case in which a variety has lost marks for commercial possibilities on account of its skin colour. It appears to be regaining some of its popularity which had waned over the last few seasons.

Up-to-Date and Field Marshal.—Neither of these varieties has done as well as in the first season--probably due to spread of virus. On the whole, however, they have maintained a good position.

Aucklander Tall-top has headed the yield on this season's results, but its poor performance last year indicated that, as mentioned in the previous report, it is a variety which requires certain conditions to yield heavily. It was placed first in five centres in the second season, but it is still impossible to give a lead as to the limiting factors in connection with this variety.

Endurance.—As a result of the second season's trials, this variety does not seem to warrant recommendation for general use, its commercial possibilities being low, while its blight susceptibility is high.

Northern Star.—Further results confirm the opinion expressed last season, that the sphere of usefulness of this variety is limited to districts where double cropping is practised.

Arran Consul has not improved its position when compared with its performance in the first season.

Iron Duke and Arran Chief have both been adversely affected by the presence of virus diseases, and the trials, so far as these varieties are concerned, have given practically no information.

Table 2.—Early Main-crop Varieties (Average of Two Seasons, 1930–31 and 1931–32).

Variety.	Cropping Power per Acre.	Range of Adaptability—0–10.	Commercial Possibilities—0–10.	Maturity.	Blight Resistance—0–10.
	Tons.			Days.	
Arran Banner ..	9·7	10	9½	156	7
Aucklander Short-top	8·1	7½	9½	157	7
Burbank*	8·0	8	7	161	7
Arran Victory* ..	7·9	7	6	163	9
Abundance	7·8	5½	8	162	3
Great Scot	7·4	5	8½	151	8½
Majestic	7·2	5	7½	152	8
Bresee's Prolific† ..	7·1	4½	6½	157	2½
King Edward ..	5·8	1	8	159	6
Average yield ..	7·6	..	..	..	..

* Results of one year's trials only. † Results misleading on account of virus disease.

Comments on Varieties in Table 2.

Arran Banner.—This variety has fully justified the recommendation made after the first season. It is again the outstanding variety in the trials.

Aucklander Short-top (commonly sold as Sutton's Supreme).—Has maintained a high position throughout the tests.

Burbank.—On the results of one season's trials only this variety has done quite well. Tubers are liable to roughness especially on heavy land. Flesh very pale lemon. Medium flavour.

Arran Victory.—A promising white-fleshed variety. It has lost marks under " Commercial Possibilities " on account of its purple skin. It is an exceptionally floury potato, with a good flavour, but seems liable to develop " brown fleck " under certain conditions.

Abundance.—This variety has not done so well in the second season. It would appear to be almost in the main-crop group, and its susceptibility to blight detracts from its value.

Great Scot.—Another variety which has not done quite so well in 1931–32. It is the earliest variety in the group and as such can be recommended.

Majestic.—Has again not come up to expectations. In certain cases the variety yields well, and under such circumstances is quite worth growing.

Bresee's Prolific.—The results from this variety tend to demonstrate the adverse effects of virus disease in a line.

King Edward.—Is again bottom in its group. This variety can only be recommended for growing in Otago and Southland ; elsewhere it is not popular.

Table 3.—Second-early Varieties (Average of Two Seasons, 1930–31 and 1931–32).

Variety.	Cropping Power per Acre.	Range of Adaptability—0–10.	Commercial Possibilities—0–10.	Maturity.	Blight Resistance—0–10.
	Tons.			Days.	
Early Regent bolter* ..	6·2	8	6	147	2
Ally	6·0	9½	8	141	5½
British Queen ..	4·8	6½	6½	146	1
Witchhill	4·2	3	7	134	4
Sharpe's Express ..	4·0	2½	6	135	1½
Average yield ..	5·0	..	..	..	..

* Results of one year's trials only.

Comments on Varieties in Table 3.

Early Regent Bolter.—This bolter selection from Early Regent has done very well in its first season of trial. The flesh is white, firm to floury. The line distributed contained a fair percentage of virus disease, so that with a healthier line an even higher yield may be obtained. Unfortunately, the variety is very susceptible to late blight.

Ally.—This variety has again done well.

British Queen has dropped in yield in the past season, and is definitely of a poorer class than either Alley or the Early Regent bolter.

Sharpe's Express and Witchhill can only be considered of use for early market and garden culture.

Table 4.—First-early Varieties (Average of Two Seasons, 1930–31 and 1931–32).

Variety	Cropping Power per Acre.	Range of Adaptability—0–10.	Commercial Possibilities—0–10.	Maturity.	Blight Resistance—0–10.
	Tons.			Days.	
Jersey Bennes* ..	5·4	10	8	142	6
Early Regent ..	5·0	8	6½	127	3
Epicure	4·2	6	7	121	2
Early Puritan ..	3·9	5½	7	127	2½
May Queen* ..	3·9	5	5	138	8
Eclipse*	3·4	2	5	141	6
Di Vernon* ..	3·3	2	6	138	8
Average yield ..	4·1	..	..	..	..

* Results of one year's trails only.

Comments on Varieties in Table 4.

Jersey Bennes.—A variety which has done very well in its first season's trials. Should become a popular first early when better known. Flesh slightly lemon. Medium flavour.

Early Regent, Epicure, and Early Puritan.—Have all performed in a similar manner to the 1930–31 season.

May Queen, Eclipse, and Di Vernon.—None of these varieties have yielded sufficiently well for them to be recommended for commercial purposes. The two first have a white flesh and good flavour ; Di Vernon is very white-fleshed, floury, with good flavour.

General Remarks.

It is pleasing to note that in both the first-early and second-early groups fresh varieties have been included which are showing considerable promise. In the past the absence of any really first-class early variety has been very noticeable. The present indications are that Jersey Bennes will largely fill the requirements in this direction.

Arran Banner has again done remarkably well, and already there is a big demand for seed of this variety.

The results of the 1931–32 trials have proved of great value in confirming the results obtained in the 1930–31 season. While it is yet impossible to attempt to determine what varieties are most suitable for any particular area, the trials have shown that certain varieties are well ahead of others for general New Zealand conditions.

The field-work in connection with these trials was carried out by field officers under the supervision of the Fields Superintendents at Auckland, Palmerston North, Christchurch, and Dunedin respectively.

The Department acknowledges the co-operation of the growers mentioned earlier in the report in providing facilities for these trials to be undertaken.

—J. W. Woodcock, Assistant Crop Experimentalist, Plant Research Station.

—J. H. Claridge, Assistant in Agronomy.

PAMPAS-GRASS AND TOETOE.

EXPERIENCE WITH PAMPAS AS WINTER FODDER.

B. C. ASTON, Chief Chemist, Department of Agriculture.

THE note on toetoe, or New Zealand plume-grass, published in this *Journal* for December, 1931, has resulted in the writer's attention being drawn to an interesting farming development with South American pampas-grass on the Hauraki Plains.

Pampas-grass, *Gynerium (Cortaderia) argenteum*, according to Cheeseman ("Manual," 1925) has established itself as a garden escape in the vicinity of Auckland and is spreading in waste places, railway cuttings, &c. It is thus a naturalized New Zealand plant, and it would appear from what follows that it is worthy of considerable attention by farmers on reclaimed swamp-land who are looking for a supplementary cattle-fodder that will never fail them. Gynerium is a genus of grasses belonging to the tribe Arundineae, and distinguished chiefly by the species having showy flower panicles. Six species are recognized, most being natives of Brazil and Chile. That which is best known and cultivated in Britain and New Zealand is *G. argenteum*, called pampas-grass because it is a native of those vast plains, the pampas of South America. It is usually planted in Europe in gardens for the ornamental effect given by the splendid plumes. It was first introduced into Britain in 1843, and distributed from the famous Glasnevin Botanic Garden.

Von Mueller ("Select Plants for Industrial Culture," 1895) refers to the pampas-grass of Uruguay, Paraguay, and La Plata States as an industrial plant because paper can be made from its leaves, as first shown by him. Toetoe is not quite so hardy as pampas, but still stands considerable frost. Buchanan ("Manual of Indigenous Grasses of New Zealand," 1880) states that rough forage can be obtained from the leaves of toetoe, particularly from plants of the succulent variety. He says that the economic value of the plant has been much overlooked, for if it is cut when in flower the leaves will be found both succulent and agreeable to stock. Experiments made on the allied pampas-grass by Sir George Grey at Kawau and Dr. S. M. Curl in the Manawatu favour the view that these coarse grasses have been neglected, and that they only require to be cut down at the proper time to ensure that stock will eat them greedily.

Dr. Curl (Transactions of the New Zealand Institute, 1876) states that pampas-grass reaches a height of 10 ft., but if within reach of stock they keep it low, being particularly fond of its rather coarse leaves, which contain a large amount of nutriment and grow through both winter and summer, cold having little effect, and as the young leaves appear all cattle and sheep will quickly eat them, leaving more delicate herbage to do so. Weathers ("Practical Guide to Garden Plants," 1901) states that pampas likes a good supply of water during the summer months. He says that pampas varies a good deal in character, which suggests that by selection better strains for grazing might be obtained. Propagation is easily effected by dividing tufts in spring, replanting them in light rich soil, and watering freely.

HAURAKI PLAINS FARMER'S EXPERIENCE.

Mr. A. McClean, of Waitakaruru, Hauraki Plains, wrote in July last that he had been for six years carrying out practical trials using pampas-grass as an auxiliary fodder for stock, particularly dairy cattle, and had obtained results which he considered most satisfactory. The results had also convinced him and others who had seen the plantations that there were great possibilities in the use of this plant, especially as a winter fodder. An analysis of pampas-grass was given in the December *Journal* article for comparison with toetoe, oaten hay, &c., with which it compared favourably. Mr. McClean's attention was first called to the matter from the fact that cattle liked the pampas-grass, and each year he kept on increasing the plantations until to-day he has 9 acres under pampas, and this is his second year of wintering stock on this grass.

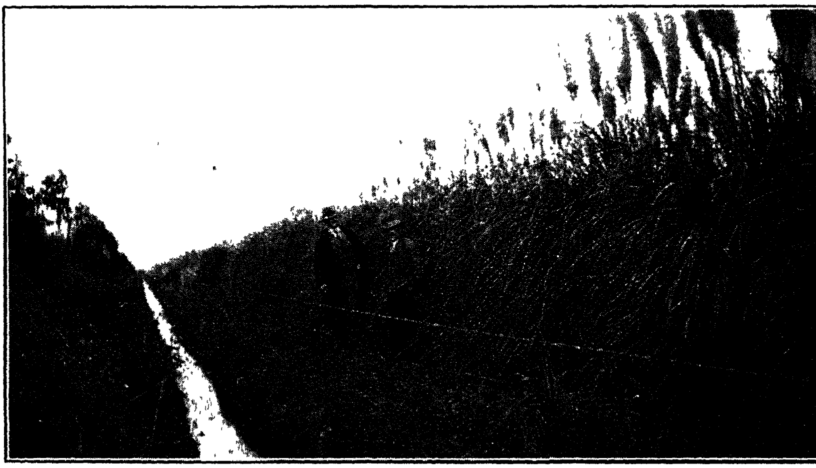


FIG. 1. PAMPAS-GRASS ON MR. McCLEAN'S FARM AT WAITAKARURU.

The tussocks were two years and eight months old from date of planting when photo was taken last May.

The accompanying photographs are by Mr. McClean, who states that his results obtained over the past three years show that he can carry on his farm of 200 acres (including 30 to 40 acres in a rough state) 200 head of cattle the whole year round. He does not need hay or any supplementary fodder, for the simple reason that the animals ignore hay if they can get pampas-grass, and they certainly do much better on the latter. His cattle are in excellent condition and keep remarkably healthy. Test cows which have spent four winters on pampas are to-day the outstanding animals on the farm, with coats and condition as if fed on linseed.

Cattle eat the pampas down themselves in breaks with a movable fence; it does not need to be cut for them. Mr. McClean has tried cutting and feeding out the pampas like other crops, but there seems to be too much wastage of material, and cattle certainly prefer grazing

the standing tussocks. This method is very economical of farm labour, only half a day per week being employed in arranging for 100 to 150 giant tussocks to be fed off, whereas feeding hay and ensilage means a daily job. Pampas grows very rapidly, approximately 1 ft. a month, until in twelve months' time each clump has about 1 cwt. of fodder.

Samples of pampas forwarded from Hauraki Plains have been analysed, and the results calculated on the green material are tabulated below, together with analyses of toetoe, green maize, and oats for comparison. The figures in parentheses are the constituents calculated on the dry matter.

	Water. Per Cent.	Ash. Per Cent.	Protein. Per Cent.	Phosphoric Acid. Per Cent.
Pampas-grass ..	71·4	2·27 (8·16)	2·46 (8·71)	0·1 (0·36)
Toetoe	..	.. (8·86)	.. (7·13)	.. (0·25)
Green maize ..	81·0	3·0 (15·0)	1·9 (9·37)	0·12 (0·62)
Green oats	82·2	1·6 (8·9)	2·7 (15·7)	0·15 (0·84)

Mr. McClean describes his farm as good swamp-land, and the photo (Fig. 1), taken in May, shows the watertable to be very near the surface. The quality of the soil affects the feeding value of a given species of pasture plant much more than is generally recognized, and it may be that pampas is exceptionally digestible and palatable when grown on a drained swamp of similar type to that of the Hauraki Plains, a warm soil well supplied with organic matter and water (for analysis see this *Journal* for June, 1914, p. 565). One would like to hear of instances of cattle grazing pampas-grass on other types of soil, as, if the utilization of this plant is generally applicable on all soils as a supplementary fodder for cattle, a great economy of pasture and of expense in growing ordinary supplementary fodders might often be effected. Even if it is only found possible to utilize swamp-lands in this way, it will be an opening for the use of a species which is now regarded as a shelter and ornamental plant.

The chemical analyses indicate that toetoe and pampas-grass are of relatively good value when compared with other green fodders—that is, if the components are equally digestible. That toetoe is extremely palatable to stock is shown by the manner roadside tussocks are grazed back in winter in the Hawke's Bay district, but if some assistance were given stock in detaching the saw-edged leaves from the tussocks, no doubt very much better utilization could be effected. Both these giant-tussock plants are quick growing.

FIG 2. COWS FEEDING ON PAMPAS IN ONE OF MR. McCLEAN'S PLANTATIONS.

"DELICIOUS SPOT" ON APPLES DUE TO *GLOEOSPORIUM PERENNANS.*

R. M. BRIEN, Mycological Laboratory, Plant Research Station, Palmerston North.

"DELICIOUS SPOT," an apple rot common to the variety Delicious, first became conspicuous in New Zealand in 1923. In that year in one line of several hundred cases, some showed as much as 60 per cent. of infection. Since then the disease has been prevalent each season in Delicious and other varieties taken from cool stores throughout the Dominion. It is essentially a storage condition, being present only on apples held in cool storage and on those kept in packing-sheds over an extended period.

Cunningham in 1923 recorded the disease under the name of "Delicious spot," but did not identify the causal organism. During the 1930 and 1931 seasons an extensive study of the fungi causing apple and pear rots in cool storage was undertaken in this Laboratory. Specimens were forwarded by the Orchard Instructors, who secured them from the main cool stores throughout the Dominion. Approximately two hundred isolations were made from apples infected with "Delicious spot," and every isolation was found to resemble closely *Gloeosporium perennans* Zeller and Childs.

This fungus was recorded by Zeller and Childs in 1925 as the cause of a perennial canker on apple-trees in the States of Oregon and Washington, and in British Columbia. These authors did not at that time consider the fruit rot produced by this organism to be of definite economic importance. In 1931 it was recorded by Heald and Ruehle as causing a "bull's-eye" rot on apples in Washington State, chiefly on Jonathan, Yellow Newtown, and Spitzenburg, and to a lesser extent on Rome Beauty, Winesap, and Delicious from other localities. In New Zealand the fungus has been obtained principally from Delicious and Sturmer, and to a lesser extent from Rokewood, Statesman, and Washington apples. The same type of rot was observed on a few specimens of Twyford Monarch and Winter Cole pears from cool storage.

The relative percentages of infection in five varieties of the diseased specimens forwarded are as follows: Delicious, 68·1; Sturmer, 29·3; Washington, 1·2; Rokewood, 0·9; and Statesman, 0·5. The disease would appear to be general throughout, since specimens were obtained from cool stores in the districts of Auckland, Gisborne, Hastings, Greytown, Nelson, Motueka, Stoke, and Christchurch. Lines from which these fruits were secured were held in stores for periods varying from four to seven months.

METHODS OF INFECTION.

Gloeosporium perennans usually penetrates apples through mechanical injuries and necrotic areas, although in some cases infection takes place on sound fruits. Injuries causing stem and calyx infection, and induced by stem, skin, and insect punctures, and to a lesser extent through russeting, sun or spray burns, and branch wounds, are the usual modes of entrance, although under favourable conditions infection

FIG. 1. LESIONS OF GLOEOSPORIUM PERENNANS ON INOCULATED DELICIOUS APPLE. NATURAL SIZE.

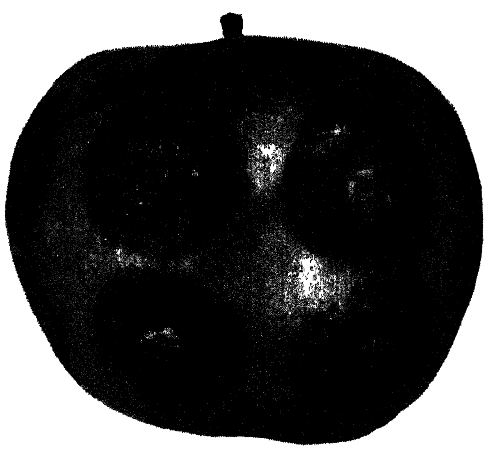


FIG. 2. LESIONS ON INOCULATED STURMER APPLE. NATURAL SIZE.

[*Photos by H. Drake.*

occurs by way of the lenticels. In one batch of thirty-two diseased fruits forwarded from a Gisborne cool store the fungus had infected twenty-two in this manner.

SYMPTOMS PRODUCED.

The disease is noticeable first as a small, slightly depressed, light-brown or chocolate coloured spot, approximately 2 mm. in diameter. When the lesion enlarges to 6–8 mm. the centre becomes yellowish-brown, the periphery remaining chocolate-brown. These are marked by zones, the peripheral zone being approximately one-sixth of the diameter. The size of the spots varies ; on fruits held in cool storage from four to five months they may attain 30–35 mm. in diameter. At first the lesions are firm, but they become spongy when mature. They are usually circular in outline except where they coalesce. Fructifications are present only on mature spots, when the acervuli form subepidermally and exude spores in dark cream gelatinous tendrils. The number of spots per fruit varies, for where severe infection has occurred by way of the lenticels they may appear in abundance and scattered over the epidermis. On the other hand, where infection has taken place through skin injuries or insect punctures, only one or two lesions may develop. Penetration occurs to a depth of 8 to 18 mm.

INOCULATION TESTS.

Inoculations were first carried out in November, 1931, on Sturmers which had been in cool storage for five months. Six cultures of *Gloeosporium perennans* were obtained from infected fruits. Apples free from rots or blemishes were surface sterilized with acidulated mercuric chloride (1–1000) for four minutes, and then washed in sterile water for ten minutes. Spores and mycelium were inserted into incisions made by a sterile scalpel, and the apples were placed in glass jars fitted as moist chambers and kept at a temperature of 10–20° C. Lesions identical with the originals developed from all six cultures.

During the present year a further series of inoculations has been carried out with Jonathan, Cox's Orange, Delicious, and Sturmer. These were inoculated by the above method every two months, from time of picking till completion of storage. After thirty days typical lesions were formed round points of inoculation on all varieties. This was the case for each set of inoculations irrespective of length of storage. On freshly picked fruits of Delicious and Sturmer lesions developed rapidly, reaching 22–26 mm., and on Jonathan and Cox's Orange 10–12 mm., in the same time. At later stages of storage there was no appreciable difference in the sizes of lesions. The spots formed were identical on all varieties. Reisolations were made from each set of inoculations, and typical cultures of the fungus secured.

MORPHOLOGY.

Cultures isolated from apples in New Zealand agree closely with those secured from Zeller, and also with the original description given by Zeller and Childs. The morphology of the New Zealand organism is cited here, since the original paper is not procurable in the Dominion. The description was drawn from fructifications on inoculated apple fruit.

Gloeosporium perennans Zeller and Childs. Oregon Agricultural College Experiment Station Bulletin 217, pp. 1–17, 1925.

Acervuli erumpent, circular, white to light-brown, 400–700 microns in diameter. At first composed of an erect cylinder of sterile hyphæ which is later surrounded and enclosed by conidiophores. Conidiophores branched, divergent, septate, hyaline

Conidia hyaline, one-celled, mostly cylindrical, sometimes curved, larger at one end, acuminate, 10–18 × 3–4, average = 12·6 × 3·1 microns, producing secondary conidia in culture.

Secondary conidia hyaline, one-celled, ovoid, sometimes curved, 3–7 × 1–2 microns

Habitat: On apple fruits in New Zealand and branches of *Pyrus malus* and *P. communis* in United States of America (Zeller and Childs l c.).

Distribution: United States of America, Western Canada, and New Zealand. In New Zealand common on stored apple fruits throughout.

SUMMARY.

(1) "Delicious spot" is one of the most serious types of decay on cool storage apples in the Dominion.

(2) It is caused by the fungus *Gloeosporium perennans* Zeller and Childs.

(3) Inoculations with spores and mycelium on Delicious, Sturmer, Cox's Orange, and Jonathan proved positive on all four varieties.

(4) The fungus is able to attack these varieties at any stage in their storage.

(5) Infection takes place through wounds, insect punctures, or directly by way of the lenticels.

(6) The symptoms and morphology of the New Zealand organism are described.

The writer wishes to thank the Orchard Instructors in the various districts who forwarded specimens for this investigation, and Mr. H. Drake for preparing the photographs.

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Conversion of Unprofitable Apple-trees.—A good example of converting unprofitable trees to another variety by the "refurnishing" system is reported by Mr. G. Stratford, Orchard Instructor, Motueka, as follows: "An orchardist on the Moutere Hills concluding that his Ribston Pippin trees were not profitable to grow, decided to work them over with Cox's Orange Pippin. After explaining to him the advantages, he decided to adopt the refurnishing system instead of the orthodox method of grafting. The leaders were stripped quite bare during the pruning season, allowing new shoots to push out all along the leaders during the following growing season. These new shoots were then budded during February, putting in anything from 150 to 200 buds per tree. The leaders were also cut back the required length and Cox's Orange Pippin scions grafted on the ends. Convenient subleaders were similarly grafted. The result was a splendid take with practically all buds and grafts, and it is anticipated that in two years' time the grower will have large Cox's Orange Pippin trees in good bearing. Probably some trouble will be experienced for a time with growths from Ribston buds, but these can be suppressed during the season." It is understood that a similar system has been practised in Tasmania and other Australian States.

INSECT TRANSMISSION OF DRY-ROT (*PHOMA LINGAM*) OF SWEDES.

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THE following account deals with work carried out subsequently to that described in this *Journal* for September, 1930, in which it was shown that dry-rot of swedes had been carried from various sources to healthy bulbs by two insects which at that time were unidentified. These have now been named, and they are the Staphylinid beetle *Atheta pseudocoriaria* Bernh. and the Drosophilid fly *Drosophila rubrostriata* Beck.

After the conclusion of the preliminary investigation it was decided that it was necessary to carry out a survey of the insects characteristically found in rotting swedes. Since the disease appears to be mechanically carried, the purpose of this was to select the most abundant and likely two for further experiment, as it would have prolonged the work unnecessarily to examine the transmitting powers of all the fauna characteristically found. As it happened, these two insects proved to be *Atheta pseudocoriaria* and *Drosophila rubrostriata*, and this paper deals with further work performed with them to demonstrate conclusively that insects carry dry-rot.

EXPERIMENTAL METHODS AND RESULTS.

The swedes used in the experiment described below were grown from seed treated against dry-rot on new ground at a special isolation block at Tangimoana where there were no other swedes for miles around. When they were a suitable size these bulbs were transferred to the laboratory and transplanted into thirty-six boxes each 18 in. by 12 in. by 6 in., placing five bulbs in each box in the manner shown in Fig. 1. Before use the boxes and soil were steam-sterilized at 98° C. for twenty minutes. Each box was provided with a wire frame over which was placed a fine mesh muslin cage as shown in Fig. 2. The muslin was glued to the box below and secured tightly above with string, so that the apparatus was insect-proof. Each box was placed in a tray as shown in Fig. 2, and the watering was thus done from below, so that there was no possibility of the spores being carried from one bulb to the other by this means. In the handling of the bulbs all care was taken to prevent accidental contamination.

Before being placed in the box cages each bulb was carefully fumigated with a heavy dose of nicotine sulphate, then cleaned, thoroughly washed in acidulated mercuric chloride solution (1–500), and subsequently carefully washed with clean water to make sure the chemical was removed. After the bulbs had been dried and arranged in the box cages the central swede in each box was inoculated with a virulent strain of the dry-rot organism from laboratory plate cultures. All the box cages were then placed on the concrete floor of an insect-proof glasshouse to wait for the disease to develop in the inoculated bulbs.

The insects used were taken from cultures bred up in the laboratory. These cultures originated from flies and beetles collected in the field

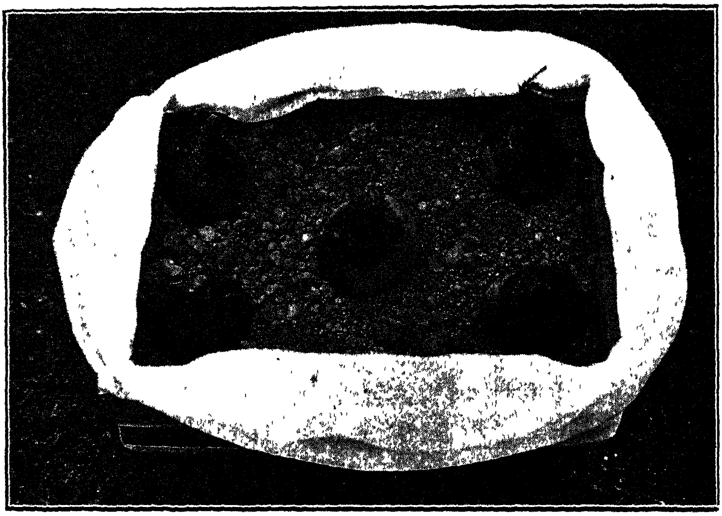

FIG. 1. SHOWING ARRANGEMENT OF THE SWEDES IN EACH BOX CAGE.

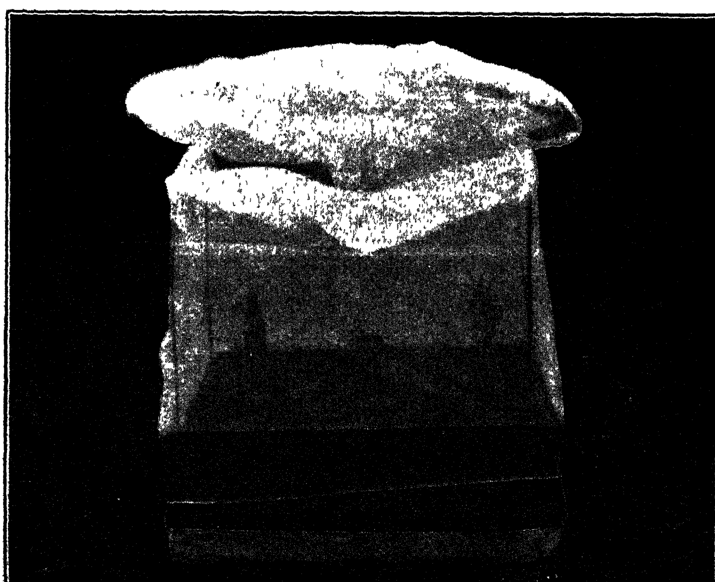

FIG. 2. BOX CAGE WITH WIRE FRAME AND MUSLIN COVER.

[*Photos by H. Drake.*

and placed in clean jars containing rotting potatoes which had been inoculated with "blackleg," a bacterial disease. The *Atheta pseudocoriaria* used in the actual transmission work had been bred on the potatoes for at least one generation; such was the case also with *Drosophila rubrostriata.* In this way insects free from contamination with dry-rot were secured, which condition was desirable since the purpose of the experiments was to demonstrate the carriage of the disease from the central bulb to the other bulbs in the box cage.

Approximately fifty days after the central bulbs had been inoculated, dry-rot had fully developed in them, and insects were placed in the box cages as follows: (*a*) Into the first lot of six box cages were placed adults of *Atheta pseudocoriaria* (bred on rotted potatoes) at the rate of approximately forty per box. The bulbs in these boxes, except the central ones, were chipped with a sterilized knife in five places. This was done to discover whether the insects transmitted the disease to damaged bulbs more readily. (*b*) Into the second lot of six box cages were placed adults of *Atheta pseudocoriaria* (bred on rotted potatoes) at the rate of approximately forty per box; these bulbs were undamaged. (*c*) Into the third lot of six box cages were placed adults of *Drosophila rubrostriata* (bred on rotted potatoes) at the rate of approximately forty per box; these bulbs were damaged by chipping as in (*a*). (*d*) Into the fourth lot of six box cages were placed adults of *Drosophila rubrostriata* (bred on rotted potatoes) at the rate of approximately forty per box: these bulbs were undamaged. (*e*) The fifth and sixth lots of six box cages remained without insects of any kind, to act as controls. During the experiment the leaves of all the swedes were kept short (see Fig. 1) with sterilized instruments to prevent any contamination by contact with other bulbs.

As rot (dry-rot, soft-rot, fusarium-rot, &c.) appeared in the bulbs round the central infected one, such diseased swedes were removed for the purpose of culturing the fungus and verifying the identification in the laboratory. It was necessary to remove these bulbs as the disease appeared, because if they were left other fungi entered the rotting material and made the identification of dry-rot very difficult. The process of removing the bulbs was as follows: Before the box cages were touched the operator's hands were washed in mercuric chloride solution (1–500). The top of the cage was then loosened and the hands, holding a cloth soaked in mercuric chloride solution (1–500) were inserted carefully into the box-cage so that no insects could escape or enter. The diseased swede was carefully loosened, but before being lifted from the surface of the soil it was wholly enveloped in the sterilized cloth mentioned above. In this state it was withdrawn from the cage very carefully so that no accidental contamination of the other bulbs could take place.

Quite a large percentage of the bulbs in the box cages became infected with soft-rot (probably bacterial) and fusarium-rot, and it became desirable to replace such diseased swedes with healthy ones. The remaining bulbs taken from the isolation area at Tangimoana were not sufficient for this purpose. Accordingly the diseased bulbs were replaced with healthy ones taken from a block grown on new ground at the Plant Research Station's experimental area. This crop was grown from seed which had been treated against dry-rot. Very little disease subsequently appeared in this crop and then at a very late

All the work was carried out in an insect-proof glasshouse, steam-heated. During the experiments, the average air temperatures were maximum, 82° F., minimum, 45° F.

Results are shown in the following table :—

Table 1.—Experiments with Insects introduced into Box Cages on 19th May, 1931, at Rate of approximately 40 Adults per Cage.

Box Cage.	Condition of Bulbs.	Number of Bulbs developing Dry-rot, and Date of Appearance of Disease.*
	Drosophila rubrostriata.	
C	Undamaged	..
D	,, ...	1 on 18th August.
E	,, ...	1 on 13th July
F	,, ...	1 on 13th July; 1 on 27th July.
G	,, ...	..
H	,, ...	..
J	Chipped	1 on 30th June; 1 on 27th July, 1 on 3rd August; 1 on 17th September.
K	,, ...	..
L	,, ...	1 on 30th June
M	,, ...	1 on 30th June, 1 on 3rd August.
N	,, ...	..
O	,, ...	1 on 30th June; 1 on 10th August; 1 on 18th August.
	Atheta pseudocoriaria.	
P	Undamaged	..
Q	,, ...	..
R	,, ...	..
S	,, ...	..
T	,, ...	..
U	,, ...	..
V	Chipped	1 on 7th July; 1 on 13th July.
W	,, ...	2 on 30th June.
X	,, ...	1 on 20th July.
Y	,, ...	1 on 20th July, 1 on 10th August.
Z	,, ...	..
A	,, ...	3 on 7th July; 1 on 8th August.
	Control (No Insects).	
Control A ..	Undamaged	..
,, B ..	,, ...	..
,, C ..	,, ...	..
,, D ..	,, ...	..
,, E ..	,, ...	..
,, F ..	,, ...	..
,, G ..	,, ...	..
,, H ..	,, ...	..
,, J ..	,, ...	1 on 18th August.
,, K ..	,, ...	..
,, L ..	,, ...	..
,, M ..	,, ...	..

* These do not include the central bulbs of the box cages, which were artificially inoculated.

Discussion and Conclusion.

Owing to an accident, dry-rot bulbs taken from box cages J, M, and O (one from each) were replaced with bulbs taken from the field. In these three cases contamination of the three new bulbs may have taken place from the soil, so that in a perusal of the table this should be borne in mind.

As additional evidence that dry-rot was not brought into the box cages by means of the bulbs taken from the field and used to replace those which went off with soft-rot, it may be stated that the percentage of bulbs replaced in the control boxes from the field was 23, that in the insect-boxes 35, while the percentage of dry-rot that subsequently developed in the control boxes was only 2, whereas in the insect-boxes it was 26. A further illustration is afforded by the following: In the six box cages containing *Drosophila rubrostriata* with undamaged bulbs four swedes developed dry-rot while five bulbs had been taken from the field to replace those which developed soft-rot. In the six box cages containing *D. rubrostriata* with chipped bulbs, ten swedes developed dry-rot while eighteen bulbs had been taken from the field to replace those which developed soft-rot. In the box cages containing *Atheta pseudocoriaria* with undamaged bulbs none developed dry-rot, while four had been taken from the field to replace those which developed soft-rot. In the six box cages containing *A. pseudocoriaria* with chipped bulbs, eleven swedes developed dry-rot, while seven had been taken from the field to replace those which developed soft-rot. In the twelve box cages of the controls, all the bulbs of which were undamaged, one swede developed dry-rot while eleven had been taken from the field to replace those which developed soft-rot.

Apart from the possibility of carriage by insects, birds, animals, &c., Cunningham (1927) showed that spores are disseminated only by rain or by actual contact, and that wind plays only an indirect part in that it brushes the leaves of a healthy plant against the diseased tissue of an adjacent one. The factors of wind and rain can of course be ruled out in these glasshouse experiments. The bulbs were watered from the bottom in trays so that there was no possibility of spore dispersion by water splashing, and at no time could the conditions in the box cages be called wet so as to produce abundant spore tendrils. The soil was kept just moist enough to provide the bulbs with enough water to keep them healthy. The leaves were kept cut right back so that there was no chance of contact by this means, and careful precautions were taken at all times to prevent accidental contamination by manipulation.

The only possible conclusion, then, is that the disease was carried from the diseased bulbs to healthy ones by the insects introduced into the box cages. From a perusal of Table 1 it will be seen that dry-rot was transmitted much more freely among the chipped than among the undamaged bulbs. This can be easily understood, because these injuries are the easiest places for the fungus to enter the bulbs after the spores have been deposited by insects wandering over the surface. This demonstrates the importance of avoiding as much injury as possible to swedes during cultivation, &c. Table 1 also shows that *Drosophila rubrostriata* transmitted more disease than did *Atheta pseudocoriaria*.

This also is easy to understand, on account of the mode of travel of the two insects. *Drosophila rubrostriata* will fly from one bulb to the other, whereas *Atheta pseudocoriaria* prefers to walk, taking to the wing only occasionally. Thus the first-named insect will make many more trips from the diseased bulbs to the healthy ones than will the other, in a given space of time.

It should be understood that although these two insects would seem to be the most important in the transmission of dry-rot, they are only representatives of the insect fauna of a dry-rotted swede, and possibly any of the typical insects of the diseased bulb would prove capable of this transmission to a greater or lesser degree, according to their habits.

The experiment has clearly demonstrated that dry-rot of swedes can be carried by insects, particularly to injured bulbs.

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WINTON DEMONSTRATION FARM.

NOTES ON THE 1931-32 SEASON'S WORK.

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NOTWITHSTANDING the low prices ruling for both dairy-produce and stock, the policy of establishing the dairy herd adopted by the committee of the Winton Experimental and Demonstration Farm some three years ago has not been interfered with to any great extent, and its continuance was one of the main features of the past season's work.

Besides carrying on those experiments already in existence, many new ones were laid down. Unfortunately a period of twelve weeks almost without rain at a most critical period was responsible for poor germination and consequent failure of many trials which would otherwise have proved of great interest to the district. The management of the pastures, exemplified by their freedom from roughage and their cleanliness, is a striking testimony to the benefits to be derived from the practice of rotational grazing.

ROTATIONAL GRAZING.

Blocks 2, 4, 8, and 10, which were devoted to rotational grazing in the 1930-31 season, were again utilized for the same purpose. The area constitutes 20 acres, comprising eight 2½-acre fields (see *Journal*, December, 1930, page 407). These fields were top-dressed with superphosphate at the rate of 3 cwt. per acre in the autumn, and four of them received an additional dressing of sulphate of ammonia at the rate of 1 cwt. per acre. Owing to the dry conditions, growth was never prolific at any period of the year, and it was only by constant harrowing, sometimes as many as three harrowings per field per month, that it was possible to milk forty-three cows and carry young stock on 40 acres of

grass. Daily records of grazing and weight of milk produced have been recorded. The experiment has been inspected regularly by many local farmers who were greatly impressed not only by seeing forty-three milking cows grazing on a 2½-acre field, but by the management of the pastures reflected in the vast difference in appearance and growth brought about by systematic harrowings.

THE STOCK.

Prior to enumerating the stock, it may be noted that the farm's total area is 91 acres. Of this just over 40 acres were down in grass, the remainder being sown in oats and grass and general winter feed. It was the committee's intention to increase the previous season's herd of thirty-two cows to fifty, and although this was not achieved a gradual increase brought the number of cows in milk to forty-three. The herd consists of grade Friesians, and has given fairly satisfactory results. With the object of raising the butterfat averages the herd was entered under the Otago and Southland Herd-testing Association, and the last test, dated 31st May, 1932, showed that the herd average was 239·17 lb. of butterfat in 219 days for forty-one cows, while for last season the average was 236·20 lb. in 216 days for thirty cows.

In addition to the dairy herd, eighteen heifers that were raised on the farm were put to a young purebred Friesian bull of well-known butterfat backing, and it is hoped to bring these heifers into the herd in October. Sixteen heifer calves selected from the best cows in the herd have been reared. These will be carried on through the season with the intention of bringing younger stock of known origin into the herd at a later date.

Red Polls: The bull, two cows, and two calves were sold in the early part of the season, this breed being deemed not suitable for local conditions.

RYE-GRASS STRAIN INVESTIGATION.

This trial, embodying some 200 plots of rye-grass from various parts of New Zealand, was sown down in October, 1929. Observations have been recorded at regular intervals on the establishment of the various strains, and botanical analyses of the plots have been made annually. To the casual observer the difference in the pasture establishment is very evident. It is now two years and a half since the plots were sown and the proportion of rye-grass in the plots sown with Hawke's Bay seed is practically the same as it was in its first season. Such is not the case with the remaining plots of Southland and Canterbury rye-grass; the proportion of rye-grass now in these is very low, and their bareness showed up to such an extent in the early part of the season that it was found necessary to affix to the notice-board a metal container with a complete plan of the experiment, to allay the curiosity of visitors.

COCKSFOOT, RED CLOVER, AND WHITE CLOVER STRAINS.

A trial similar in layout to the rye-grass experiment was sown in 1929. A line of perennial rye-grass from Hawke's Bay was used as a base, to this being added for each plot a strain of cocksfoot or clover. Records have been kept as to the establishment, grazing, and growth of the various plots. A summary of the observations shows that the establishment of cocksfoot has been poor. The red clovers established

to a fair degree, the most noticeable being Montgomery Red, which has withstood ordinary farm grazing conditions to a remarkable degree. Many of the white clovers show good establishment, foremost among these being a selected line from Hawke's Bay (A.C. 311), while another exceptionally good plot, No. 40, a Kentish white clover (A.C. 109). Comparing these plots with the Danish white, which has practically disappeared, and the imported white, which is equally poor, it is easily inferred that New Zealand has a white clover greatly superior to most of the imported lines.

TRIALS WITH CRUCIFEROUS CROPS.

Block 15, which had been in turnips and swedes for two seasons, was again ploughed in December for turnips. This area was known to be badly infested with club-root.

A turnip manurial trial, embodying basic slag, super, and super plus lime, was laid down during dry weather, but faulty germination resulted in the abandonment of it from an experimental point of view. Adjoining this trial, five replications, 3 chains long, of Bruce Purple-top turnip, Bruce Green-top, and Hardy Green Globe were sown. It was noted throughout the season that both types of the Bruce turnip were very vigorous growers. At a farmer's field-day on 6th April a portion of each drill of the trial was pulled, and it was clearly seen that the bulbs of the Bruce turnips were free from club-root, though some had slight infection of the roots. In the case of the control plot, Hardy Green Globe, it was seen that the bulbs had over 90 per cent. infection. In May, prior to feeding off the block, a club-root count was taken, and the average of a series showed that infection on bulbs was Bruce Purple-top 16 per cent., Bruce Green-top 18 per cent., and Hardy Green Globe 96 per cent. Infection of roots was Bruce Purple-top 34 per cent., and Bruce Green-top 60 per cent. (very slight infection).

Ten replications of fourteen varieties of swedes were sown in November, but germination was very irregular; it was found that some of the seeds germinated forty-one days after sowing. From a yield point of view the trial was worthless, but considerable interest was evinced by the farmers who inspected the crop for shape and type. Among these varieties the Herning was in evidence, and contrary to the usual assumption that Herning is a poor yielder many bulbs weighed 15 lb. to 17 lb. and were of good shape, with no indication of club-root. Another swede, Sutton's Green-top, was noted more for prolific growth of top than for its size of bulb. It is thought that this swede, which makes rapid growth, would do well for lamb feed. The Central Otago swede, Hunt's Superlative, has grown very well, and compares very favourably with commercial strains of Superlative.

A swede manurial trial, with ten replications of six different types of fertilizer, was sown in mid-November. This suffered in the same manner as others in the matter of germination, and so proved of little account from an experimental point of view.

FORAGE CROPS.

Uneven germination nullified a forage-crop trial with kohl rabi, broad-leaf Essex rape, Kangaroo rape, thousand-headed kale, Maori cabbage, and chou moellier, also a manurial trial on chou moellier. In

spite of these adverse conditions and the resowing of many of the trials a sufficiency of winter feed was provided for the stock. A splendid crop of chou moellier standing 4 ft. to 4 ft. 6 in. high, with some stems 3 in. in diameter, proved a valuable asset in maintaining the milk-supply. The swede crop averaged 40 to 45 tons per acre.

POTATO TRIALS.

Continuing the origin of seed trial with the seed from the previous year's test, a small area was planted in October. This was harvested in April, and a quantity of seed sent to Canterbury for a comparative trial there. Sufficient seed was retained on the farm to plant the present season's trial, which will conclude this experiment. From these results it is hoped to obtain some definite information as to the districts most suitable for the production of seed potatoes.

MISCELLANEOUS.

Blocks 14 and 15, comprising over 22 acres, were sown down in oats and grass in November, the grass mixture being certified rye-grass first harvest seed, timothy, crested dogstail, New Zealand white clover, Montgomery red clover, and cow-grass. The oats were cut green and converted into hay. The strike of grass was very good. After the oat crop was cut, the fields were top-dressed with 2½ cwt. of super per acre. A new windmill and concrete trough were erected on the dividing fence in a convenient site for the subdivision of these blocks.

Half of Block 15, which surrounded the dismantled meat-works, was ploughed with a swamp plough in May, and the ridge on the block has since been planted with trees.

Throughout the season the Winton Experimental and Demonstration Farm Committee acted under the guidance of the re-elected chairman, Mr. D. H. McLean, of Caroline. The practical work in connection with the numerous experiments has been in the capable hands of the Manager, Mr. G. L. Smart.

A SYSTEM FOR SELECTING VARIETIES OF FRUIT-TREES.

M. DAVEY, Orchard Instructor, Mapua, Nelson.

THE selection of fruit-tree varieties is one of those matters which exercises the minds of most commercial fruitgrowers, and often, despite much thought, leaves the solution in a state of uncertainty. Orchard Instructors are frequently called upon to make recommendations in this direction, and without some system of appraising the various values which may be attributed to the various varieties it may prove unsatisfactory to tender advice.

In order that some reasonably sound base may be available the writer suggests the employment of a pointing system which should, independent of changing conditions, arrive at a fairly correct selection. The headings under which such points could be awarded together with the maximum scale, might be as follows: Ruling market values of variety, 25 points; comparative yield, 10; freedom from disease, pests,

and rejects, 20; quality for dessert, 10; suitability for cooking, 10; harvesting and packing, 5; constitution and vigour of tree, 5; storage life of fruit, 15: total, 100 points.

These points are intended to suggest approximate value, and can be adjusted to meet the personal opinion of individual growers. It must be remembered that localities and local conditions have an important bearing on the various factors.

The following comments on the values scheduled may be of assistance in arriving at a decision:—

Ruling Market Values.—A careful perusal and analysis of account-sales, pool averages, and other returns which become available should be made in establishing this point. Potential value should also have a bearing on the matter. Note should be made of the upward or downward trend of any one variety, using a graph system over a period of not less than three seasons.

Comparative Yield.—This should be arrived at by a comparison of the crop production over a period of, say, five years, records to be applied to trees of approximately the same age. One should not depart from the practice of comparing dessert varieties with dessert varieties and cooking varieties with cooking varieties, otherwise the position becomes much more involved.

Freedom from Disease, Pests, and Rejects.—There is little doubt that this aspect is uppermost in the minds of most growers in selecting varieties for either planting or reworking; but it is as well that something more than a mental analysis be made. Annual records should be kept of the fruit passed through the packing-shed, and the amount of each variety discarded as unfit for local or export markets. The writer is conscious of the fact that it is not practicable to keep a record of the fruit affected under the different causes of rejection, but even this can be mentally and fairly correctly assessed by the grower and recorded in proportion to the total rejects.

Quality for Dessert.—Although this matter may be subject to individual tastes, the orchardist himself should be a first-class judge of quality in a dessert apple. If the grower's personal taste is too pronounced in one direction, outside opinions on this point are not hard to obtain. Size and appearance should also be taken into consideration in assessing the value of a dessert apple or pear.

In regard to size, particular markets may prefer a very different range; therefore a mean or average size for the markets served should be the aim in the mind of the grower. Regarding appearance, pronounced bright colour, be it red or yellow, combined with refinement of shape, is most appealing to the consumer, whether it be on the table, in the shop, or on the advertising poster.

Suitability for Cooking.—With regard to apples or pears for culinary purposes, again individual tastes differ, some consumers preferring an apple which breaks down in the process of cooking. Size has a bearing on this aspect. Generally speaking, the largest varieties with low sugar content, such as Ballarat Seedling and Dunn's Favourite, are in the class which breaks down on cooking. This class of fruit is more suitable for baking. In Britain and possibly on the Continent a much larger proportion of apples are served in this form than in New Zealand. It is fairly safe to state that the majority of consumers

prefer an apple which cooks thoroughly and still retains the shape to which it has been divided. The preference of the canning factory seems to give a lead in this direction.

As with the dessert varieties, size and appearance also count with the buyer; invariably large sizes appeal for cooking, as less waste and time is entailed in preparing for the table. Under appearance a clear skin, be it green or yellow, is the most sought for. Russet and blemish greatly discount the face value of a cooking-apple, a fact which is possibly not fully appreciated, but which has to be recognized.

Harvesting and Packing.—Under this heading are features which possibly do not receive as much consideration as is warranted. Size of the variety may be partially covered by yield, but the cost of harvesting and packing small or large varieties is far apart. An endeavour should be made to avoid selecting varieties which are naturally very small. If ultimately the selling of apples and pears by count becomes a general practice this feature may be somewhat discounted, but the relatively high cost of harvesting and packing small apples or pears will remain.

Period of ripening should also be considered in conjunction with operation of the packing-shed. It is undoubtedly very desirable that a succession of ripening periods be aimed at for the convenience of packing and shipping. If more thought could have been given to this aspect at the time of planting most of the commercial orchards, a great deal of anxiety to which growers are now subject would have been avoided.

Constitution and Vigour of Tree.—It is inevitable that considerable loss of revenue must eventuate where trees in full bearing are cut down and reworked. Therefore a quick recovery is most desirable, and varieties which are not only vigorous and lend themselves to light pruning, also those which are precocious in forming fruit buds, should be selected. Possibly the outstanding variety of apple to which this description may be applied is Desert Gold. The writer's experience is that this variety is best dealt with by light pruning after the second year from reworking, and that under such treatment it will not only grow vigorously, but will also carry considerable fruit on one-year-old wood. Trees lacking in natural vigour are invariably below average size, which automatically reduces their carrying-capacity, and in addition generally demands special attention with regard to fertilizers, which entails extra cost of production.

Storage Life of Fruit.—This factor is gradually being minimized by improved methods of handling and refrigeration. However, too large a quantity of fruit is still classed on the markets as wasty. This condition depreciates the value of any perishable product in the mind of the buyer more than any other fault. It is yearly emphasized by the comparatively high returns for fruit which carries well and opens up in good condition, despite the fact that it is known to be of poorer quality in other respects.

In conclusion, the writer realizes that the various headings under which it is suggested the value of varieties may be assessed somewhat overlap each other, but the aspects are so closely related it is difficult to entirely avoid this. It is trusted that the suggested assessment may be helpful and enable the orchardist to form a fairly satisfactory opinion on a matter which must always be subject to review.

SEASONAL NOTES.

THE FARM.

Control of Pastures in Summer.

DURING November and December the development of flowering or rank growth on pastures under grazing should be avoided as far as possible. Leafy pasture growth as a rule provides a highly suitable feed for milking-stock and for animals which are growing rapidly, whereas the stemmy or woody pasture growth that develops when flowering occurs is decidedly poor feed for such stock. The leafy growth is characterized by a markedly greater content of mineral matter, which is required for the formation of milk and bone, by a markedly greater content of protein, which is essential for the formation of milk and flesh, and by superior digestibility—about 80 per cent. of the dry matter of leafy growth is digestible, whereas only from 40 to 50 per cent. of the dry matter of stemmy growth is so. Further, pastures which are allowed to become tall and stemmy in summer assume a relatively inactive condition during a considerable and critical portion of the producing season—*i.e.*, during late summer and early autumn—whereas pastures which have not been allowed to develop to the flowering stage tend to a more prolonged and continuous production of leafy feed.

Much of the difficulty of preventing an undue development of flower heads would disappear were ensilage more extensively practised. The amount of hay it is ordinarily considered necessary to save is insufficient to absorb all the growth made in October to December in excess of the current requirements of stock. The direct result is understocking of the pastures during that period, with consequent development of rank growth unless the surplus not required for hay is utilized in ensilage.

In practice it frequently proves impossible to estimate exactly the area of grass sufficient to provide the feed required by stock. Farmers who rightly believe in good feeding usually prefer to have some feed to spare instead of being short of feed. An amount of surplus feed that may arise in this way may not be sufficient to justify its saving in the form of silage, but still be sufficient to lead to poor control of the pasture growth if it is not removed. When this is so, the most satisfactory course is to check the development of rank stemmy portions in a field by topping of the pastures—*i.e.*, running the mower over the fields to remove flower-heads. There is a tendency to delay such topping until it is far too late to obtain the maximum benefits from it.

Dry stock may often advantageously be employed to remove the topped growth, which stock consume readily when it has become partly wilted, although they neglect it before it is unmown. But even if it is impossible to provide for the consumption of the wilted topped growth it is sound practice in the interests of future production of the sward to carry out topping.

For thoroughly efficient control of the growth of pastures in summer, ensilage and topping of pastures need to be suitably associated with rotational grazing carried out in a manner which is practicable under New Zealand conditions, and which has been described previously in these notes.

Forage-crop Production.

On a great number of farms the success attained in the year 1933 will be determined to a considerable extent by the cropping work done during the next few weeks. This is because on those farms feeding of stock is a matter of basic importance, and much of the foundation of next year's

feed-supply consists of the cropping work calling for attention at the present time. Highly productive animals, such as the modern dairy cow of heavy yield and the lamb of rapid growth, require highly productive feed, which is essentially highly digestible feed. Mangels, swedes, carrots, chou moellier, rape, and leafy lucerne are all highly digestible, and hence provide highly productive feed.

The dominant source of highly productive feed in New Zealand farming is unquestionably well managed leafy grassland, but during periods of low rate of grass-growth other sources of supply have to be exploited. Herein lies the urgent need for the more extensive growing of such crops as mentioned.

Maximum Profits through Maximum Yields.—It is difficult to over-emphasize that as a rule the key to maximum profits with this class of forage crop is heavy yield. This arises from the fact that the difference between the cost of a heavy crop and that of a light one is often relatively small. To obtain any crop a considerable amount of expense has to be faced to cover such items as rent or interest on land, ploughing and other cultivation, drilling, manure, and seed. The point of importance is that a relatively small added outlay in additional cultivation or additional manure may make the difference between a good crop and only half a crop. To take a concrete instance, an additional £1 10s. per acre spent on manure and an extra £1 10s. on intertillage of the growing crop may readily make the difference between a 35-ton and a 65-ton crop of mangels. In such a case 30 tons of mangels would be obtained for a direct outlay of £3. From this it follows that portion of the heavier mangel crop is secured at the rate of 2s. a ton, which is obviously good business when it is kept in mind that mangels are worth about 10s. a ton if hay is bringing £3 a ton.

Some may be inclined to scoff at such a supposition as rather far fetched, but in so doing they are overlooking two hard facts of the position. The first of these is that it is far from uncommon to find 65-ton crops of mangels produced under conditions of soil and climate essentially similar to those under which 35-ton crops of mangels are produced. The second fact is that the difference between such crops may almost invariably be traced to the fact that the larger crops received the benefit of more thorough cultivation and of more liberal manuring. While the mangel has been mentioned in the instance just considered, it is well to remember that the position is similar in respect to other crops.

Main Factors governing Yield.—Three of the main factors giving efficiency in forage cropping are of current importance. One is the use of good seed. The saving of a few pence or even a few shillings an acre on seed for forage crops is almost invariably parsimony instead of economy. Commonly, the small saving is associated with comparatively poor germination or low vigour of seed, or with poor type or strain of plants. Poor germination or poor vigour may lead readily to a poor strike, especially if conditions are at all adverse at the time the seedlings may be expected to develop. Evidence is not lacking that complete or partial failures of forage crops are due at times to the use of seed of poor germinating capacity and vigour, and some of the poor strikes that it has been customary to attribute to unfavourable weather or attacks of pests, such as the "fly," might really have been caused by poor seed.

A second factor which favours the production of profitable heavy crops is liberal manuring to increase the fertility of the land to an extent which makes it conform to the full producing potentialities of the crop. The general position may be grasped from the fact that while the error of overmanuring of forage crops is practically unknown, that of under-manuring is widespread. It does not seem to be realized generally that in the case of even the least nutritious of the ordinary forage crops the value of a ton of the crops is more than sufficient to pay for 1 cwt. of the

fertilizer commonly used with them. This reduced to concrete form means that an increase of 2 tons an acre in a swede or chou moellier crop due to the use of 2 cwt. of fertilizer would be a profitable undertaking.

A third factor is adequate cultivation. The use of good seed and liberal manuring will prove, to some extent at least, futile unless associated with cultivation thorough enough to make the supply of air and moisture in the soil approach as near as possible to the needs of the maximum crop obtainable from the seed and manure used. At this season it seems timely to remark that the cultivation employed in the preparation of seed-beds for forage crops is often markedly below the requirements of the crop to be grown and that a poor crop could be foretold even before the sowing of the seed, and this even though liberal manuring and use of best of seed be practised.

Mangel-growing.

The mangel is particularly reliable, partly because it can withstand drought comparatively well and partly because it is not subject, as yet, in New Zealand to any serious pest or disease. When suitably treated it is characterized by very heavy yields, and this leads to the production of feed of remarkably low cost. This is to some extent indicated by the fact that a mangel crop of 60 tons an acre, which is not at all exceptional, yields as much feed as would be yielded in a year by 5 to 6 acres of pasture characterized by a carrying-capacity equivalent to one cow to 2 acres; and it is of considerable moment that this feed is available when there is marked need for it—*i.e.*, when the feed from grass is in short supply. Good treatment for the mangel is specially necessary. Preparatory cultivation should produce a fine firm seed-bed, in the absence of which poor yields may readily result even though suitable provision of seed and manure is made.

The variety Prizewinner Yellow Globe holds pride of place in point of popularity—a place which it deserves on the basis of field experience. Other varieties of known value are Red Intermediate, White Sugar, and Jersey Queen. Current standard practice is to sow about 6 lb. of seed per acre in rows 26 to 28 in. apart. As wet cold conditions tend to cause loss or stunting of seedlings, sowing should be delayed until warm soil conditions may be expected. Over wide areas November sowing is generally suitable.

As the manurial requirements of mangels are determined to a considerable extent by soil and climatic conditions it is inadvisable to prescribe any manurial dressing as the most suitable one for general use. But guidance as to what constitutes effective manuring may be gained from the fact that over wide areas good results may be expected from a dressing of 5 to 6 cwt. per acre of a mixture consisting of equal parts of superphosphate and blood and bone, or three parts of superphosphate to two parts of bone and blood. Further, it is widely accepted that such a mixture could often well be supplemented with about 3 cwt. per acre of kainit or of agricultural salt. Kainit, which contains 14 per cent. of potash as well as a considerable amount of salt, and which is not substantially dearer than agricultural salt, usually should be utilized, when it is considered that the mangel crop would benefit from potash as well as from salt.

Field Carrots.

On farms possessing areas of free-working loams the field carrot, given good cultivation, is capable of heavy yields. This is indicated by the fact that in farmers' field-crop competitions in three recent seasons 134 crops have averaged over 43 tons an acre, and have included crops which yielded in the vicinity of 70 tons an acre. Good results may be expected from a manurial dressing of 3 to 5 cwt. per acre of a mixture consisting

of two parts super and one part blood and bone. Varieties which have maintained popularity over a considerable number of years are Matchless White, Barriball, White Belgian, and Guerande. Guerande, which is a very suitable variety for sheep, is successfully grown, without thinning, in rows 21 to 26 in. apart, $1\frac{1}{2}$ lb. of seed per acre being used. With other varieties good results are frequently obtained by hand thinning and cultivating carrots sown in drills 21 to 26 in. apart, but sowing in 14-in. drills also gives heavy yields. The amount of seed generally used is 1 to $1\frac{1}{2}$ lb. an acre. Success generally attends sowing in November.

Lucerne.

A fine firm seed-bed is required for fully successful establishment of this important crop. Rapid and vigorous development of seedlings, which is desirable, is favoured by warmth, and because of this need of warmth the best results are generally obtained by sowing during the latter part of November or December. It is good practice to sow through every coulter of the grain-drill 12 to 18 lb. per acre of seed of Marlborough origin. Alternatively the seed may be broadcast and covered by light harrowing. Lime may as a rule be applied with advantage before the final cultivation preceding seed-sowing.

Treatment of the seed with a suitable culture is advisable, in order to ensure the presence of specific organisms upon the activity of which the ultimate success of the lucerne at times depends. Cultures are obtainable at a small cost from the Department, and prepaid orders for them should be placed about fourteen days before it is expected to sow the seed.

Ensilage.

Frequently too late harvesting of the silage crop occurs. This is a serious weakness in that it leads to (1) unduly woody silage possessing from the feeding viewpoint all the disadvantages associated with over-maturity in pasture growth; (2) less assurance of a substantial leafy aftermath which is at times of distinct value during the latter part of summer; (3) increased harm to the permanent sward due to the longer period during which shading and opening of the sward by the tall growth takes place.

Early ensilage is especially desirable in regard to the first cut of the season from a lucerne stand. This cut often contains a considerable proportion of weeds. As a rule, the longer such weeds are left unmown the more they weaken the lucerne plants. If the first cut of lucerne is harvested for silage in good time it opens the way to an extra cut annually from the lucerne field.

As a means of minimizing external wastage in stack silage, round stacks are being preferred to other shapes. In pits and trenches unnecessary wastage at times occurs because the material is not consolidated enough at the time of its collection. It may be looked upon as practically impossible to bring about overconsolidation.

—R. P. Connell, Fields Division, Palmerston North.

Precautions against Caseous Lymphadenitis in Sheep.

Now that the shearing season has again arrived it is opportune to issue a word of advice in regard to precautions to be taken at shearing to prevent the spread of the disease known as caseous lymphadenitis in sheep, which has come into prominence of late years owing to the decision of the inspecting authorities in Great Britain to examine for and reject all mutton or lamb affected with this disease.

The trouble is located more frequently in the lymphatic glands or " kernels " situated in the upper regions of the limbs, and this suggested

that the more common mode of entry of the organism is through inoculation of the wounds accidently made during shearing and crutching, castrating and docking, &c. This view has been confirmed by experimental inoculation of skin wounds at the Wallaceville Veterinary Laboratory.

It is customary where hand shearing is practised to frequently dip the blades in a reliable antiseptic, and this should always be done. It is most important that all wounds, whether caused during operations or accidentally, should be at once dressed with some antiseptic preparation. Any of the standard disinfectant solutions are suitable for use, according to directions given on the containers. If this precaution were carefully and efficiently observed in every case it would be of the greatest value in assisting towards preventing the setting-up of lymphadenitis in the sheep which have sustained the wounds, and also in helping to prevent the spread of the disease generally.

Sufficient evidence exists to warrant giving the advice that wherever the trouble is known to be present among the sheep on any farm it will be a wise and desirable precautionary measure to either saturate the soil of the yards with a strong antiseptic solution—say, one part of non-poisonous dip to twenty parts of water—or, what is better still, to dress thoroughly the surface soil with quicklime and then turn it over. In addition to the yards, there is a possibility that nearby holding-paddocks may be more or less contaminated. Where it can be conveniently done, it will be a good plan to plough up, cultivate, and resow such paddocks at intervals of a few years.

The dressing of all wounds seen at shearing-time and crutching is a very necessary precaution. This fact is brought to the notice of the Department from time to time when losses occur from blood-poisoning after shearing. Any extra labour involved is therefore worth the trouble by reducing the prevalence of lymphadenitis and also as a preventive of blood-poisoning. That ewes are more commonly affected is due to the fact that, owing to their longer life, they are more often exposed to infection of wounds liable to be caused during shearing and crutching.

Further information regarding lymphadenitis is given in the Department's Bulletin No. 140, which may be obtained free on application.

—*Live-stock Division.*

THE ORCHARD.

Spraying Operations.

Pip Fruits.—When these notes reach growers in the earlier districts the calyx spray for codlin moth will have been applied or will be in the course of application. In later districts early November should see this operation completed. Some growers, especially in Otago, have not yet realized the necessity for this spray, and often delay it until the eye of the young forming fruit is closed. In Otago the delay may be safe in some seasons, but a season occasionally occurs which upsets all calculations, with disastrous results. Moreover, seldom is it unnecessary to apply a spray at this period for other pests and diseases; indeed, it is generally necessary to apply it as soon after blossoming as possible so as to lessen the time which has elapsed since the pink spray. The addition of arsenate of lead, therefore, is a very small item, and will act as an insurance.

With the calyx spray of 1½ lb. powder arsenate of lead per 100 gallons of water for the control of codlin moth may be combined other insecticides and fungicides. If control of leaf-hopper is necessary include 1 pint of nicotine sulphate. Bordeaux mixture, 3–4–50 (3½–2–50 if hydrated lime is used), or lime-sulphur, 1 in 120 to 170 according to the strength (sulphide

sulphur content) of the material purchased, will be necessary if black-spot is troublesome; of the two, lime-sulphur is preferable on varieties subject to russet, or if either powdery mildew or red mite is a factor.

Later sprays will probably consist of applications of arsenate of lead, 1½ lb. per 100 gallons water, lime-sulphur, 1 in 120 to 170, and a finely divided sulphur, 2 to 5 lb. per 100 gallons, according to the article used. It will be necessary to make these applications at intervals of ten days to three weeks according to locality and necessity. By including spreader at the rate of ½ lb. to ¾ lb. per 100 gallons in each application efficiency is greatly increased. The addition of 4 lb. to 6 lb. of hydrated lime to the 100 gallons of wash will considerably reduce any liability to burning of the foliage.

In the event of red-mite infection becoming serious the addition of ⅜ gallon of winter oil to 100 gallons of the mixture will prove very effective. The use of "summer" or so-called "white" oils, although effective against red mite, must be restricted to applications at such times when there is no residue of sulphur or lime-sulphur on the trees, and neither of the latter should be applied for some weeks after the trees have received an application of a summer oil.

Stone Fruits.—For the control of brown-rot and other fungi lime-sulphur, 1 in 120 to 170 (according to strength), will probably have been applied at petal-fall. Another application is advisable as soon as the calyces have fallen from the young forming fruit. When peach-green aphis first makes its appearance add nicotine sulphate, 1 in 800, to the lime-sulphur. As nicotine sulphate is in itself inert, it requires such substances as arsenate of lead, bordeaux, lime-sulphur, or soap to liberate the nicotine which is the actual killing agent; therefore, if it is to be used alone, add 2 to 4 lb. of soap per 100 gallons of wash. The effectiveness of nicotine lies in its volatility, and as it becomes more volatile with increasing heat more effective work is done with this spray in hot weather.

Leech on Cherries, Plums, and Young Pear-trees.—With the first appearance of leech eggs on the leaves an application of arsenate of lead, 1½ lb., and spreader, ½ to ¾ lb., per 100 gallons of water should be made. At this time the fruit is not far advanced, and is not likely to have its appearance spoiled by the spray, especially if a spreader is used. This spray gives a good coating to the earlier developed leaves, which will remain for a considerable time. Through the maturing and picking season a spray on a still day directed not at the tree but upwards in the air above it, so that it will fall like a mist on the tree, will afford additional protection to the older leaves, also some will fall on many of the young leaves, while very little will be deposited on the fruit. The leech grub does not remain on one portion of the leaf or even on the one leaf, but travels to a number, and is liable to be poisoned before it has moved very far. Much injury has been done to cherry-trees by neglecting the control of leech during the season when the fruit is on the trees, and considerable protection of the foliage has been achieved with a very light mist in the manner described without disfigurement to the fruit.

Cultivation.

Where the soil has been worked down to a good tilth harrowing, with an occasional heavier working with cultivator and disks, especially after heavy rain or irrigation, will be the main operation in this branch of operation. Where difficulty has been experienced earlier in the spring in obtaining efficient pulverization of the soil, the opportunity should be taken when clods have been softened by rain. Every effort should be made to conserve the moisture in the soil by regular and intelligent working with the most suitable implement at the time, so that the top soil is friable, devoid

of lumps, and has an even surface but without a crust, so that the smallest surface possible is exposed to drying winds, and yet leaving it in such a condition that the air can percolate through. Such a condition of soil will materially assist the action of the bacteria in changing the unavailable plant-food already in the soil and that supplied by manures into a form in which the trees can absorb it, thus assisting growth, increasing the leaf-surface, and, in consequence, improving the quality of the crop generally.

Grafts and Buds.

Trees that have been worked over either by budding last autumn or grafting this spring, must receive constant attention. Almost daily visits are necessary for a while to see that no openings have been caused by the growth of the scion. Many a graft has been saved from an early death by pushing over the cracks a little of the surplus wax which is almost always to be found around the working, thus excluding the air from the union. Where there have been misses, healthy shoots should be encouraged to grow from the stock by protecting them from overgrowth of undesirable shoots; the former can then be budded in the autumn to fill up the gaps with very little loss of time. Remove as few as possible of the shoots coming from the stock, but control them by shortening back; they will assist very materially in keeping vigour in a tree that has already been so severely dealt with by heading back for reworking.

Thinning the Fruit.

The thinning of all stone and pip fruit, especially peaches, nectarines, apricots, and apples, is now recognized as essential to the proper maturing of a good-quality crop. In Central Otago it is a regular orchard practice with practically all stone and pip fruits, its neglect being looked upon just as severely as the omission of pruning or spraying. Much will depend on the vigour of the tree and the surrounding circumstances as to the extent of thinning necessary, but it is good practice to thin heavily on poorly growing trees leaving more fruit to mature on the more vigorous ones. In these times only high-quality fruit is likely to command good prices, especially in the case of stone fruit. Eliminate, therefore, poor and marked fruits, and any surplus above which it is considered the tree can mature to a good size and grade. To get the best results thinning should be done early—that is, as soon as the early drop is over. In districts where late spring frosts occur it may be well to thin twice, merely singling the fruits as early as possible at the first thinning, and giving a final one when danger from frost is over.

—*W. R. L. Williams, Orchard Instructor, Alexandra.*

Citrus Culture.

Collar-rot is in evidence in quite a number of citrus orchards, and this disease becomes very troublesome unless it receives attention from the grower. The first indication that the tree is attacked by collar-rot is often the presence of an exudation of gum from the trunk. If the area of gumming is examined the bark in the vicinity will be found at first usually discoloured and moist, later becoming dry and brittle. Infection generally commences near the soil-level and works upward. The disease develops slowly, but will eventually ringbark the tree if left unchecked. Young trees develop a yellowing of the leaves and a general thin appearance of the foliage, but the upper portions of older trees do not show this weakness until the disease has made considerable headway.

Possibly one of the main causes of collar-rot is faulty drainage, while trees planted too deeply will also be susceptible to the disease. Treatment consists of the removal of all the diseased bark, together with a

small portion of the healthy bark all round the edges. The wounds should then be painted over with bordeaux paste. Stockholm tar has given good results in some cases and does not cause any injury to the exposed healthy tissue, with the result that new bark is formed almost at once over the wound surface.

General routine work should be continued, as the neglect of even a minor operation may cause undue loss to the grower. Cultivation should be given at regular intervals during the next few months in order to maintain the trees in a good growing condition. Spraying for the control of the various pests and diseases should also be kept in view from time to time, and each spray applied in its proper season.

Budding may be done during October or deferred until the autumn. If the work is done in the spring the shoots may be headed back to a bud at about New Year, when good wood-growth will develop during the autumn.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Late-hatched Chicks.

It is only in exceptional cases, and where specially favourable conditions are present, that it will pay to hatch November chicks. If, therefore, more chicks are required there should now be no further delay in securing them, for the later the hatching the lower will be the productive capacity of the flock. Too often the late-hatched birds are turned into stale quarters and runs, and also have not the protection from hot weather which nature demands, with the result that they fail to make satisfactory development as compared with chickens hatched earlier in the season.

The drawbacks of late hatching can be counteracted to a great extent by placing the chickens in a clean fresh run which has the advantage of being well shaded. Their quarters should be scrupulously clean, as a preventive against parasitic infestation making its appearance and the young birds receiving a set-back as a consequence. At all costs guard against overcrowding, remembering that the smaller the number of chickens in a flock the better will they thrive. Do not attempt to rear weaklings or deformed stock, as these should never be bothered with. Better far to destroy them at the outset and save the worry of trying to rear birds which, even if they come to maturity, may never pay for their keep. Again, it is the weakling which usually catches every passing ailment, and may thus be the means of introducing serious trouble into the flock.

The late-hatched chickens must be supplied with ample good palatable food. If birds of any age are to thrive and do well plenty of good nourishing food is necessary, and this applies especially where late-hatched pullets are concerned. With the advent of summer conditions, growing birds are apt to leave their food, especially on very hot days, and consequently are likely to receive a set-back from which they never recover. The fact of the birds not appreciating their food does not necessarily mean that they are being overfed, and more often it indicates that they are tired of the one class of food that is being provided. When this occurs it is advisable to change the ration and make it as appetizing as possible. Where milk is available, the mash mixture should be moistened with this. It not only makes the food more appetizing but also tends to promote good health and sound development in the growing bird. In addition, milk has great value as a drink. If there is any doubt as to the merits of milk for chickens the poultry-keeper should conduct a test, giving one lot of chickens milk and another hot water, and watch results. It may be contended that milk adheres to the feathers of the birds, giving them

an unsightly appearance. Admittedly this applies where the milk is provided in an open receptacle, but not so where proper drinking vessels, specially made for the purpose, are used. It goes without saying that the drinking vessels should be frequently washed in hot water and maintained in a clean, sanitary state.

Then again, if the chickens are to make sound development succulent green material cannot be oversupplied. Indeed, when hot weather conditions prevail they will half live upon green food, if given the opportunity. Where watercress is available this will prove an excellent food for growing stock or, indeed, for birds of all ages. This valuable food grows in close reach of many poultry-keepers who never use it, simply because they do not realize its value. Probably there is no better green food grown than watercress for toning up the system and generally promoting good health in all classes of poultry stock.

Separating the Male Birds.

On all plants where hatching operations have terminated for the season male birds should be separated from the hens, which will lay as well, if not better, without the males. It is seldom that a male bird can be depended upon for breeding purposes after the third season, and the keeping of such stock means a continual drain on profits. The aim of the poultry-keeper should be to avoid having on the plant a bird which has passed its best period of usefulness. Hence it will pay to dispose of all old cocks at once. Even young males which are showing signs of an impaired constitution, and which do not promise to be serviceable for future breeding purposes, should also be got rid of. It should be remembered that strong constitutional vigour is the basis of disease resistance and heavy producing stock, and that no bird should be retained on the plant for breeding purposes which is lacking in this respect.

Disposing of Surplus Cockerels.

There should be no delay in marketing all surplus cockerels that have reached the age of about five months. If these are got rid of it will not only mean better conditions for the remaining stock, but will also save labour and money. It should be borne in mind that once a bird passes the chicken stage it costs more to feed and grows less in value every day. Cockerels which have been well fed and managed up to, say, five months' old will be found with good frames and in a good table condition, but when kept longer they commence making feathers and bone, and are not then in a fair condition again until they reach a mature stage. Even if a fully developed cockerel is marketed in absolutely prime condition, it is not favoured by the high-class poulterer, to whom it is known as a stag. The fact of its having a well-grown spur sharp at the point condemns it as a desirable roasting fowl, and its value is reduced accordingly. Such a bird is coarse and larger than is generally desired for the high-class trade. It is the flesh of the prime four to five months' old bird that is most sought after and which commands the highest price.

Cockerels intended for market should be separated from the pullets as soon as the sex can be determined. It is practically impossible to prime cockerels when on range and having the company of females. When the priming process begins, at about three and a half months, exercise must be curtailed, as too much of this does not tend towards rapid flesh formation.

The poultry-keeper should not try to prime cockerels on inferior or damaged food. If a maximum amount of flesh is to be produced in a minimum of time the food should be sound and fed with a free hand. Only soft food should be given. A suitable mash may be made from two parts of bran and one part each of finely-ground wheat-meal and maize-meal, with 5 per cent. by weight of meat-meal added, the whole being moistened

with hot water or skim milk, and mixed into a crumbly mass. Feed three times a day as much as the birds will eat up clean. Succulent green food can be fed in abundance, but separately, and where skim-milk is available it may be given in large quantities to drink, while grit should be in reach of the birds at all times to pick at. Above all, see that the birds themselves, as well as the quarters, are free from vermin, for however good the food may be, the birds will fail to put on the desired weight if insect pests are present.

In view of the high prices which the consuming public are being asked to pay for prime table chickens, as compared with the ruling rate for fresh eggs, there should be every inducement to the producer to feed and manage his surplus cockerels in such a way that they will command the highest ruling prices. Especially should this apply during the forthcoming festive season.

Hens losing Feathers from Back.

A correspondent is very concerned regarding some of his fowls losing feathers from their backs, and asks if this is due to feather-pulling. This condition is found only when the hens are running with male birds. It need not cause any anxiety, as the bare places will soon feather over when the male birds are removed from the pen. It is always the best layers which become affected in this way, and particularly where the birds are overmated on the male side or the males are very vigorous.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Swarming and how to deal with it.

UNTIL a beekeeper has passed through his first season it is well to depend upon natural swarming for any increase required. After a season's experience a more reliable method may be adopted for enlarging his operations. If increase by natural swarming is followed it is well to effect delay so far as the first swarms of the season are concerned. Very early swarms are not advisable, as the weather and flow of nectar are not always to be relied upon. Usually the swarms are smaller than when delayed, and may have to be fed should the weather prove unfavourable after they have been hived. On the other hand, when swarming has been delayed for two to three weeks the weather and flow of nectar are certain to be much more favourable. In any case the swarms will be larger, and the work of the parent hive and the swarm will go on rapidly and without interruption.

One of the chief factors in delaying swarming is to enlarge the hive. By giving the colony a super more working room is provided, the nurse-bees are kept busy, and the queen has additional combs in which to lay. Of course, there is a right and wrong time for doing this. The best time to add additional supers is when the brood-chamber is getting fairly full of bees, the weather mild, with a fair flow of nectar, and before queen-cells are started. If the supers are placed on the hives before there is a good force of bees and plenty of emerging brood, there is a danger of the extra space causing a check on brood-rearing, as the additional space will affect the temperature of the hive. However, if the supers are not put on before queen-cells are started it will be too late to have the desired effect, and the preparations for swarming will proceed.

When putting on the supers, if the weather is mild, a frame containing a little sealed brood should be transferred from the brood-chamber to the centre of the upper box, and also two of the side frames of comb, all with adhering bees, placing the latter combs one on each side of that containing brood, and filling their places below with drawn-out combs or frames of foundation.

The presence of several queen-cells in a hive points almost invariably to the fact that swarming is about to take place. When a number of queen-cells are sealed the swarm emerges headed by the old queen, accompanied by the majority of the field-bees. The swarm will seek an alighting-place, usually some distance from the hive, and cluster there like a huge bunch of grapes, while skirmishers from the cluster will go further afield seeking a permanent home. However, the beekeeper usually intervenes and provides the permanent home before the swarm has decided on one. The swarm is gathered into a box, which is placed in the shade, and towards sunset is transferred to a clean hive in its permanent position. Next day work starts with vigour, and, given favourable weather, within a week honey and pollen and worker-eggs will be appearing in the combs. The presence of worker-eggs is an indication that the colony is queen-right.

In the parent hive the young queen will be developing, and the first one to hatch will, unless prevented by the workers, crawl over the combs and endeavour to tear down any other queen-cells she may find and to sting to death their occupants. If foiled in this she will probably lead another swarm from the hive. This may occur three or four times in one hive, leaving the parent stock badly reduced in numbers and the beekeeper with several small swarms which will be useless to provide a surplus. The remedy for this state of affairs is for the beekeeper to examine the hive immediately after the first swarm has emerged, and himself destroy or remove all the queen-cells but one or two.

Unless there is a good honey-flow, or if bad weather sets in, the swarms should be fed inside the hive. This is to give them a good start, and to provide them with material for producing wax. Excellent combs can be produced from sugar syrup. Only the best white cane-sugar should be fed. It is advisable in all cases to hive the swarm on full sheets of foundation, and thus take advantage of the natural instinct of the bees to produce wax after swarming. Very little time will be gained if the bees are put on to drawn-out combs.

Frequent examinations of the colonies—every week or ten days during the swarming season—for the purpose of cutting out queen-cells will help to check swarming, but this requires considerable work, and, since it frequently fails in spite of every care, is not usually relied on.

The occurrence of swarming is largely due to overcrowded brood-chambers. This condition of affairs irritates the nurse-bees, which start rearing queen-cells; therefore the queen should be given plenty of room to lay. A suitable plan is to remove all the frames of brood, except the two centre combs, from the bottom chamber. Empty combs or frames fitted with sheets of foundation are put in their place. Secure the queen, and confine her in the new brood-chamber below a queen-excluder, placing the old brood-nest directly above, thus giving additional work for the nurse-bees and plenty of room for the queen to lay in. In six to eight days examine the top frames, and remove any queen-cells that may have been built. If for some reason this plan is not desirable, swarming may be controlled and the strength of the colonies equalized by transferring part of the brood from the strong to the weaker ones. Empty worker combs or frames fitted with sheets of foundation are used to replace the transferred brood-combs.

The age of the queen is another factor in promoting swarming. Just as the poultryman relies on his pullets for greater egg-production, so the beekeeper should rely on young queens, and the sooner he realizes this the less trouble he will have in keeping swarming down to a minimum. It is the exception for the queen of the current season's rearing to swarm. Ventilation also plays an important part in controlling the natural inclination to swarm, and care should be taken to provide sufficient at all times of

the season. No single system will be found universally effective. Climatic conditions frequently play an important part in bee behaviour. It will be found, however, that the methods stated, or a variation of the same employed either singly or in combination, will materially assist in the prevention of swarming.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

ATTENTION to seedling crops is most important at the present time. Heavy rain compacts the surface and frequently forms a hard crust that facilitates evaporation and is disastrous to young seedlings unless it is broken up to conserve moisture and aerate the soil. In land that has become foul with seeds of weeds, prompt attention is also necessary on fine days to hoe the crops lightly and destroy the young seedling weeds so soon as they appear. To wait until they are obvious is not satisfactory ; the work should be done as soon as they are seen by close examination. If the crops have been sown thinly, as advised, thinning the seedlings will be comparatively light work ; but it should be done promptly in dull weather as soon as the plants are of a sufficient size to be conveniently handled. This work is of the greatest importance, and failures are commonly due to its neglect.

In dry localities where good summer cabbage cannot be grown satisfactorily excellent substitutes are silver-beet (Swiss chard) and New Zealand spinach. These flourish under such conditions and by many people are preferred. Plants of New Zealand spinach should be set out 3 ft. apart, or seeds may be sown and thinned to the distance named. Sow also quick-maturing turnips in a cool place, and lettuce thinly to mature where sown. November is usually the time selected for sowing Swedish turnips, but in warm localities it is often best deferred for a few weeks.

As small fruits and many kinds of vegetables are available towards the end of November, it is advisable to stop cutting asparagus and pulling rhubarb. If a good dressing of manure is applied then the plantations will soon make the strong growth upon which future crops depend.

Small Fruits.

The harvest of small fruits will soon commence, gooseberries and strawberries being the first to mature. Fruit-picking is usually considered pleasant and easy work, requiring little experience, but this is far from the truth ; it demands steady concentration and consistent judgment from the picker, or serious loss of crop is incurred and the reputation of the garden is ruined. Strawberries must not be picked while there is moisture on the plants. In cool weather and for nearby markets they should be picked riper than for shipping long distances. For heavy cropping they must be picked clean at short intervals. They should be picked with a stem ¼ in. long, the small and misshapen berries for culinary use being placed in a separate receptacle. The berries should be placed in the punnet in a compact manner and the punnet well filled ; they will not then shake down in transit and cause damage and disappointment. As the packed punnets are placed aside by the pickers they should not be allowed to remain in the sun, but be gathered promptly and taken to a cool place and packed in clean crates. No fruit is so popular with the public as clean strawberries consistently packed. If the delivery is well spread and judiciously advertised, it should be profitable. In the past two things have often spoiled much of the trade in this perishable fruit ; they are high prices and unsatisfactory packing.

Strawberry plants for stock should not be allowed to fruit; by removing the blossom, runners are formed more quickly, and if the numbers to each plant are limited they will be vigorous and ready for early planting in the autumn.

On a light rich soil in warm localities the Cape gooseberry (*Physalis peruviana*) carries very good crops that are usually in demand at profitable prices. They should be planted out now in land that is well prepared; 3 ft. between the plants and 6 ft. between the rows are suitable distances. They will crop for two or three seasons before replanting is necessary on fresh land.

A fruit which might well be grown to a greater extent is the tree tomato (*Cyphomandra betacea*). It requires good land and a well sheltered position, and is suitable only for planting in the warmer districts. The fruit is said to be particularly delicious when cooked. It is a perennial, growing to a height of 6 to 8 ft., and may be planted now about 3 ft. or 4 ft. apart. At present a limited supply of fruit is available during the winter months. It is quite a good keeper and carries well.

That indispensable ingredient in the fruit salad—the passion-fruit (*Passiflora edulis*)—may be sown now in boxes, and pricked out in boxes later about 4 in. apart, and grown on for planting out in October next year; or the seed may be sown now where the plants are to grow permanently. Sow a few seeds at intervals of 9 ft. or 10 ft., with about the same distance between the rows. Further particulars were given in the August number of the *Journal*. The passion-fruit requires a light rich soil for consistent heavy cropping, also good drainage and shelter.

Tomato Crops.

In the unheated glasshouse the first picking of ripe fruit is usually made towards the end of November. It is customary to trim off the lower leaves from around the bottom bunch to expose it to the sunlight to ripen; it also has the effect of assisting in the circulation of the air and in ventilation which now usually becomes difficult owing to the dense foliage and the large amount of moisture given off. The tomato plant demands a comparatively dry atmosphere and moderate temperatures. If these are not maintained the foliage soon becomes soft, thin, and abnormal, and very subject to the leaf-mould fungus *Cladosporium fulvum*. This disease is fully described in last month's *Journal* in an article from the Plant Research Station at Palmerston North, which should be carefully studied. Leaf-mould causes great loss annually in the tomato crop under glass, and it is preventable if the right treatment is given.

Leaves trimmed off should be carried out and burnt. Where the subsoil is of a shingly open character, and considerable watering is necessary, it is advisable to mulch the plants by spreading a light dressing of strawy stable manure over the surface of the ground. By doing this water is conserved and the plants fed at a time when it will be most beneficial. In the absence of stable manure clean straw may be used. An occasional application of liquid manure will now be beneficial, but it must be remembered that great harm may be caused by overdoing it. In this solution sulphate of potash should be included, as it will do much to counteract the tendency to abnormality of the crop under glass.

Where the tomato crop is to be grown outside planting-out will now have to be considered. Good preparation of the land is the first essential. Especially where the land is light should a green cover-crop be ploughed under, followed by a dressing of phosphate and potash worked in with the cultivator or harrows. This is frequently composed of 2 oz. superphosphate per square yard (5 cwt. per acre) and 1 oz. sulphate of potash, together with a liberal allowance of bone-meal, but where the land is rich in nitrogen the potash should be increased. If it is desired to drill in

manure down the planting rows it should be well mixed in and done two weeks or so before planting. In no instance should manure be placed in the hole made for setting the plant.

It should be obvious that a good crop cannot be grown from poor plants, but it is not uncommon to find the attempt being made. Unless the plants are clean, sturdy, and well hardened off, it is better not to plant them. They should be well watered the day before planting, and when taken out on to the ground the individual plants should be carefully lifted with as much soil as possible and set deep and firmly in the ground; 12 to 15 in. apart and 3 ft. between the rows is average spacing, and at these distances it will take about 12,000 plants to the acre.

In sheltered localities stakes are sometimes set for supporting the plants; but more often a wire trellis is used. Light cultivation should be given every week or so after planting; it greatly encourages growth and prevents the establishment of weeds; deep cultivation is often injurious, especially after the plants are established.

The stem-boring caterpillar, which did so much damage two seasons ago, was prevented from attacking the plants last season by timely applications of arsenate of lead. That experience must not be forgotten, or the misfortune will undoubtedly recur.

The Homestead Garden.

In order to master the science and art of the garden it is necessary to carefully harvest the experience of each season as it passes and retain what is valuable by giving it careful consideration, sometimes even recording it in the garden note-book. In one's own garden, and others visited, impressive results are often seen that are of the greatest value to those who desire to excel. Very much admired during the past month or two was a large group of the star-flower (*Triteleia uniflora*), a visitor from Buenos Aires. Growing on a dry bank supported by rocks, and associated with mats of aubretia, the white starry flowers trembling on invisible stems about 6 in. high never failed to appeal. It is not the least trouble, the position suits the plant, and it is vigorous without solicitous attention. The long succession of daffodils, commencing with paper-white polyanthus in midwinter, to the poeticus or pheasant's eye in October, are equally at home in the foreground of a shrubbery where they have grown for years without being lifted. They spring up in their season in lusty sheaves of blossom of surprising quality. A little further back in the border lilies of many kinds, nerines (Guernsey lily), vallotas (Scarborough lily), belladonnas (*Amaryllis belladona*), montbretia, agapanthus, and watsonia, flourish amazingly with little attention and make a gorgeous procession. They are certainly not improved by fussy attention, and enjoy their peaceful environment.

Herbaceous plants that are annual, biennial, and even perennial, being more ephemeral, have to be renewed from time to time, and so require special quarters. Wallflowers and other biennials are sown now for flowering next season. Primroses and polyanthus, when flowering is done, should be lifted, divided, and planted in a cool, shaded place until autumn. Herbaceous perennials should be severely thinned and staked in good time. If they are fed when in full growth the blossom will be improved.

Suckers should be removed from roses; also the new wood should be thinned by pruning where it is crowded, especially about the centre of the bushes. Sucker growth from rambler roses should be thinned, leaving only a few of the strongest canes, which should be tied in so soon as they are sufficiently hardened. Wall plants should be mulched and watered, especially if they are young and the weather is at all dry.

—*W. C. Hyde, Horticulturist, Wellington.*

WEATHER RECORDS: SEPTEMBER, 1932.

Dominion Meteorological Office.

DURING each of the past five months rainfall has been below normal for the greater part of the Dominion, and the last three months have been exceptionally dry. Taken as a whole, indeed, the period has probably been the driest, for the time of year, experienced during the past sixty or seventy years. Nevertheless, as regards September, in eastern districts of the North Island, from Hawke's Bay to East Cape and in parts of the Coromandel Peninsula, more than the normal rainfall was received, Hawke's Bay particularly having a very wet month.

As regards temperature and sunshine, the prevailing easterly winds exercised a marked controlling influence on the conditions experienced. On the east coast, especially of the North Island, sunshine was very much below average. The persistent dull weather resulted in temperatures, also, being much below normal, although after the 3rd there was no really very cold weather. But the farther westwards one goes, the greater is the improvement noted, until on the west coast, as, for instance, at New Plymouth and Hokitika, and in parts of the interior, both temperature and sunshine prove to have been above the average for September.

Pressure Systems.—There was an extraordinary persistence of high pressure around New Zealand during September, but especially in about latitude 45° S. On the 1st and 2nd a fairly deep double westerly depression passed, both primary and secondary bringing pressures in the neighbourhood of 29·4 in. to the southern extremity of the Dominion. Thereafter, barometers practically never fell below 29·8 in. in the Foveaux Strait area. It was in connection with the depression of the 1st and 2nd that the only typical, strong north-westerly winds occurred, while the southerly winds following it on the 3rd brought the last touch of real winter weather, snow falling on the high levels and hail on parts of the east coast.

Another series of westerly depressions passed between the 5th and the 8th, but they were shallow and the winds accompanying them were not strong. Nevertheless, they brought the heaviest rains experienced during the month to the west coast of the South Island.

On the 9th a very intense anticyclone advanced across the South Tasman Sea. The centre, as it passed on the 10th, was just to the south of New Zealand, and barometers at several places read over 30·7 in At this time of year one expects the anticyclones to pass well to the north. The consequence of this departure from normal conditions was that the prevailing pressure gradient was reversed, there being a fall towards the north instead of a rise. In place of the usual westerlies or north-westerlies, winds between south and east were experienced. These conditions prevailed with only few and short breaks until the end of the month. There is no record of a similar spell of weather in past years. During the period a number of cyclones formed off the central east coast of Australia. There was much stormy weather on the New South Wales coast, and vessels crossing the Tasman Sea reported strong easterly winds of unprecedented persistence. By the time the cyclones reached New Zealand most of their energy was expended. The principal ones passed on the nights of the 15th and 19th respectively and on the afternoon of the 27th. The last mentioned was the deepest and its centre crossed the Auckland Peninsula, while the others followed more northerly tracks. Each of them caused widespread rain. That of the 15th was responsible for the only really good rain experienced in the eastern portion of the South Island, Canterbury, particularly, having moderate to heavy rains. In connection with the last one, heavy thunderstorms occurred in parts of the Auckland Peninsula. This depression caused very persistent and, in places, heavy rain in Hawke's Bay.

Apple-grading Machines.—Mr. M. Davey, Orchard Instructor, Mapua, writes: "Machines of the rope grader type can be improved by replacing the ropes with high tension rubber hose. This alteration obviates two weaknesses in rope graders—namely, contraction and expansion of the ropes under the influences of dry and moist atmospheres, and the difficulty of cleansing the ropes, the hose being readily washed with soap and water."

RAINFALLS FOR SEPTEMBER, 1932, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average September Rainfall.
North Island				
	Inches.		Inches.	Inches.
Kaitaia	3·16	15	1·02	5·02
Russel	2·93	11	0·60	3·96
Whangarei	4·41	15	1·14	4·87
Auckland	2·39	15	0·54	3·71
Hamilton	1·38	13	0·37	4·41
Rotorua	2·15	9	0·42	5·13
Kawhia	1·82	9	0·36	4·67
New Plymouth	1·98	14	0·57	5·06
Riversdale, Inglewood	3·51	12	0·73	9·69
Whangamomona	1·20	6	0·43	7·32
Eltham	..	..	..	4·58
Tairua	7·06	13	2·54	4·81
Tauranga	2·93	11	1·02	4·39
Maraehako Station, Opotiki	2·30	13	0·80	4·31
Gisborne	3·66	10	0·98	2·98
Taupo	1·40	11	0·42	3·89
Napier	3·70	15	0·92	2·22
Hastings	4·34	14	2·50	2·55
Taihape	1·10	9	0·31	3·23
Masterton	1·41	15	0·26	3·06
Patea	1·42	10	0·38	3·68
Wanganui	1·04	6	0·45	2·91
Foxton	0·61	7	0·14	2·49
Wellington	1·05	15	0·16	3·11
South Island.				
Westport	5·00	13	2·08	8·30
Greymouth	6·18	12	1·55	8·18
Hokitika	6·01	13	2·05	9·21
Ross	5·11	8	1·79	12·77
Arthur's Pass	5·33	8	2·30	14·97
Okuru	4·20	5	1·80	12·21
Collingwood	3·57	7	1·99	9·67
Nelson	1·16	6	0·79	3·69
Spring Creek	0·60	6	0·26	2·67
Hanmer Springs	2·67	9	0·69	4·65
Highfield, Waiau	1·22	5	0·68	3·03
Gore Bay	1·42	10	0·39	3·02
Christchurch	1·04	12	0·29	1·74
Timaru	0·95	4	0·73	1·94
Lambrook Station, Fairlie	1·49	7	0·63	2·20
Benmore Station, Clearburn	1·43	7	0·67	1·95
Oamaru	1·17	9	0·66	1·66
Queenstown	1·44	4	0·70	2·57
Clyde	0·96	7	0·52	1·05
Dunedin	1·18	9	0·64	2·75
Wendon	1·58	8	0·50	2·47
Gore	..	..	..	2·84
Invercargill	1·02	11	0·34	3·27
Puysegur Point	3·25	11	1·09	6·54
Half-moon Bay	1·29	12	0·26	5·24

Supply of Lucerne Cultures.—All orders for lucerne cultures prepared by the Department of Agriculture for inoculation purposes should be addressed to the Director, Fields Division, P.O. Box 442, Palmerston North. Charges are as follows: 2 oz. bottle, 2s.; 3 oz., 4s.; 4 oz., 6s.; 6 oz., 8s.

NUMBER AND CLASSIFICATION OF SHEEP IN NEW ZEALAND AS AT 30th APRIL.

TABLE I.—SUMMARY BY SHEEP DISTRICTS, 1932.

Class.	Auckland.	Napier-Gisborne.	Wellington-West Coast.	Marlborough-Nelson-Westland.	Canterbury-Kaikoura.	Otago (including Southland).	Total in Dominion.
Stud rams (entered in flock-book)	1,790	1,228	4,149	822	4,617	4,563	17,169
Other rams	49,484	102,176	93,942	19,322	87,344	99,604	451,882
Wethers	339,728	491,500	498,886	242,993	474,220	683,499	2,730,826
Breeding-ewes	1,807,831	3,835,873	3,527,292	778,036	3,396,623	3,717,405	17,063,060
Dry ewes	126,881	254,261	200,310	76,891	302,756	307,079	1,268,178
Lambs	666,640	1,595,890	1,349,126	330,829	1,373,154	1,845,034	7,160,673
Totals, 1932 ..	2,992,354	6,280,928	5,673,705	1,448,903	5,638,714	6,657,184	28,691,788
Totals, 1931 ..	3,311,406	6,424,856	6,150,614	1,496,927	5,707,731	6,700,982	29,792,516

TABLE II.—COMPARATIVE STATEMENT: TEN YEARS, 1923–32.

Year.	Stud and Flock Rams.	Stud Breeding-ewes.	Stud Dry Ewes.	Stud Lambs	Total Stud Sheep and Flock Rams.	Sheep of Distinctive Breed not entered in Flock-books, and Crossbred Sheep				Grand Total, Stud and other Sheep.
						Wethers	Breeding-ewes.	Dry Ewes.	Lambs.	
1923	330,055	172,843	9,013	119,749	631,660	2,551,627	12,890,160	808,919	6,199,073	23,081,439
1924	332,814	179,533	9,727	132,137	654,211	2,807,832	12,896,561	1,036,723	6,381,249	23,775,776
1925	355,579	184,744	7,867	131,485	679,675	3,063,663	13,530,479	875,899	6,398,239	24,547,955
1926	370,535	192,055	10,053	138,526	711,169	3,212,435	13,756,197	1,069,682	6,155,510	24,904,993
1927	388,274	199,219	8,644	144,897	741,034	3,074,974	14,632,511	823,047	6,377,450	25,649,016
1928	396,351	205,720	7,347	145,969	755,387	3,024,647	15,328,331	861,780	7,163,653	27,133,810
1929	422,331	219,802	7,203	156,526	805,862	3,289,135	16,388,353	875,495	7,692,537	29,051,382
1930	448,617	244,480	7,884	174,862	875,843	3,367,916	17,319,695	1,069,788	8,208,045	30,841,287
1931	461,998	238,281	8,081	169,879	878,239	3,429,552	17,370,448	1,202,633	6,911,644	29,792,516
1932	469,051	232,006	7,855	164,750	873,662	2,730,826	16,831,054	1,260,323	6,995,923	28,691,788

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

ARTHRITIS IN LAMBS.

D. S., Hinds :—

Can you advise me how to deal with what I take to be arthritis in lambs ? A number of lambs in the mob are affected, of ages from one to three weeks. The lambs appear well otherwise, but are so cramped in the legs as hardly to be able to walk at all. They are on a big clean paddock which was spelled all winter, and rock salt is provided. The lambs are Corriedales

The Live-stock Division :—

Arthritis in lambs is due to a specific organism which has a special propensity for settling in the joints of the new-born animal, where it sets up an inflammation with a certain amount of pus formation in the joint. The infection may gain entrance at birth through the unhealed umbilicus (navel) at the time of or immediately after birth, or more often through wounds following tailing or castrating. There is no specific cure for this disease, but experience has shown that gentle exercise, especially late in the evening and early in the morning, somewhat allays the mortality, chiefly due to the fact that the lamb on being disturbed is able to obtain the necessary nourishment from the ewe which it would not obtain when lying down. As a means of prevention, all carcasses of animals dying from any disease should be either burned or buried deeply in lime to prevent contamination of the soil and pastures Ewes about to lamb should be placed on fresh clean pastures Lambs should be marked and tailed in temporary yards erected in clean paddocks as free as possible from contamination from any animal affected with disease. All instruments used at marking should be sterilized by boiling, and clean boiled water and reliable antiseptics should be freely used during the operations. The tailings, &c., should not be left to be spread over the pastures, but should be either burned or buried.

COMMERCIAL GROWING OF ALMONDS.

S. A. EDWARD, Whangarei Heads :—

I would like to know of the commercial possibilities of almond trees—whether they flourish in a seaside situation on second-class land, whether they crop sufficiently well enough to pay, and whether any particular root or stock is necessary ; and, if so, if obtainable in New Zealand.

The Horticulture Division :—

Almonds are grown only to a small extent in this country at present, chiefly in Hawke's Bay and Otago for home use. Experience demonstrates that good crops of excellent quality can be grown in those areas, but to compete commercially with the low cost in Europe and cheap transport, economical methods of production and marketing would have to be evolved here. For this reason it is advisable to prove your locality with a well-chosen variety test before attempting commercial planting. Almonds require a good light soil that is well drained and a position not subject to heavy spring frosts. A seaside situation and second-class land such as you describe does not sound promising for commercial production. Good trees may be obtained from nurserymen in the Dominion.

Noxious Weeds Orders.—The Patangata County Council has declared milk or variegated thistle to be a noxious weed within that county. The Pohangina County has similarly declared gorse within its territory.

KILLINGS AT MEAT-EXPORT WORKS.

THE following table, compiled from Meat Producers Board statistics, gives particulars of aggregate killings and/or equivalent output at meat-export works in New Zealand for the past five years ended 30th September:—

Year ended 30th September.	Beef Quarters.	Mutton Carcasses.	Lamb Carcasses.	Pork Carcasses.	Boned Beef =Freight Carcasses.	Sundries =Freight Carcasses.	Total Equivalent in 60 lb. Freight Carcasses.
1927–28	394,821	2,005,333	5,947,197	147,601	283,749	125,200	6,998,086
1928–29	151,115	1,751,979	5,971,557	159,297	161,597	153,331	6,152,695
1929–30	177,379	2,621,275	6,925,859	133,591	194,311	229,673	7,506,227
1930–31	143,169	2,132,532	7,783,528	132,400	266,315	307,461	7,358,865
1931–32	186,530	2,872,860	8,804,889	152,877	340,337	290,614	8,682,588

CONTROL OF MAMMITIS IN DAIRY COWS.

THE following statements appear in an article by Dr. Minett, of the Research Institute of Animal Pathology, London, in the *Bulletin de l'Office International des Epizooties* for May–June, 1932:—

"According to certain observers, good results have been obtained in the prevention and treatment of mastitis with vaccines and some success has been recorded also after local or general treatment with chemical substances, especially in cases just commencing. It is doubtful whether these conclusions are justified, the symptoms disappearing frequently during the course of the natural evolution of the disease without other treatment than frequent stripping. It is certain that we do not possess up to now experimental demonstration that sound animals can be immunized or that a complete cure, in the bacteriological sense, can be obtained by an efficacious method. It is as well to have this present knowledge in mind when one examines means of prevention.

"Mastitis in the cow, and in particular the chronic streptococcic form, is so distributed and of such considerable importance that the problem of prophylaxis has become urgent. Up to now any treatment, chemio-therapeutical or immunological, has given no truly satisfactory results, but it is already sufficiently shown that the loss caused by chronic streptococcic mastitis can be considerably reduced by sanitary measures, which implies only the separation of infected milking-cows. For success, the first essential is that all cases of latent infection of the mammary gland should be discovered. It necessitates the utilization, for diagnosis, of laboratory methods; but if, as it is desirable, the examinations are to be conducted on a large scale, conveniently equipped laboratories would be necessary, and without these organization would necessarily be expensive."

Powdered Bluestone for Drenching Sheep.—Mr. L. C. Tonkin, Ettrick, Otago, writes as follows: "From time to time bluestone solution is recommended for drenching sheep and lambs, but perhaps farmers are not generally aware that bluestone can be purchased in powdered form. As we are orchardists as well as farmers we find use of the powdered form very handy. In drenching 600 hoggets three times we merely dissolve 1½ oz. of powdered bluestone in a cooking-bowl holding a gallon of water (it dissolves in cold water immediately). We dip out with a small medicine glass graduated in tablespoonfuls, and giving two tablespoonfuls we find it very easy to dip up the exact amount practically every time. The medicine glass is quite handy enough for pouring the solution down the sheep's throat. The powdered form of bluestone would seem handy also for foot-rot purposes, and a small quantity could be powdered on to any affected foot."

The New Zealand

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THE GOVERNMENT PURE SEED STATION.

OBJECTIVE AND WORK OF THE LINCOLN ESTABLISHMENT.

J. W. HADFIELD, Plant Research Station, Palmerston North, and R. THOMSON, Pure Seed Station, Lincoln.

INVESTIGATIONS on seed production were commenced by the Department of Agriculture in 1927, and during the initial stages facilities were afforded by the Fields Division on its Experimental Farm at Ashburton. When this farm was closed in 1931 the seed-production work was transferred to its present location at Lincoln. Since then the Canterbury Agricultural College has assisted most liberally in every possible way.

The Government Pure Seed Station comprises 52 acres of land leased by the Department of Agriculture from the Canterbury Agricultural College. It has been established with the definite objective of raising nucleus lines of high-quality seed for distribution to farmers, and the investigation of problems connected therewith. The land is flat and of a comparatively even nature, consisting of a heavy loam overlying a sandy clay. Immediate requirements have been met by the erection of a combined barn and workroom, and water and power have been laid on.

The farm is compact in shape and has been subdivided into four areas of 11 acres each, and one of 8 acres. The four large areas are worked under a four-course rotation as follows: Cereals, potatoes, peas and linseed, green manure and fallow. The remaining 8 acres has also been subdivided into four sections, and is worked under the same rotation. These small areas are used for the numerous trial plots connected with the work.

This rotation is probably open to criticism, but has been adopted only after the most careful consideration. It affords ample time for a thorough preparation of the land between each crop, and the elimination of self-sown material which inevitably arises however carefully the crops are harvested. Italian rye-grass has been chosen as a green manure, since it is a good smothering crop and is unlikely to introduce or perpetuate diseases which might affect the seed crops.

A determined attempt is made to eliminate disease, and no material which might be a source of infection is introduced on to the farm.

The College authorities have kindly co-operated in this by making available small isolation areas, where material which could not be introduced on to the farm can be grown under observation for a season.

CROP IMPROVEMENT.

Growers are becoming more and more discriminating in regard to the purchase of agricultural seeds. Impaired germination, inadaptability of the variety or strain, seed-borne diseases, and inherently low vigour are all contributory factors rendering seed unproductive. The realization of these facts, more particularly those relating to strain differences, is one of the outstanding features of modern agriculture.

The average farm crop is regarded by the plant-breeder as a collection of individual plants which are not all alike. In this mixed population variations in height, yield, maturity, seed, and many characters of this kind can be detected, and they form a basis for selection. In attempting any improvement within a variety the individual plants have first to be studied to determine what promising variants are present, and these are then increased and tested.

This preliminary study of the crop, entailing the isolation and investigation of its component strains, occupies a considerable amount of time and necessitates extensive plot work of a technical nature. So far, investigations at the Pure Seed Station have been confined mainly to those varieties which have proved themselves under New Zealand conditions, but having explored all possible avenues in this direction further advancement will entail the introduction and testing of varieties from other countries, and finally the crossing of selected individuals, having in view some definite objective. The stage is approaching when further development in certain crops will necessitate the application of more advanced methods.

These introductory remarks will serve to convey an idea of the objectives in view. In some crops, notably potatoes, wheat, and barley, seed is being distributed annually; in peas and linseed this stage is about to be reached; simultaneously other crops are being studied which will, in due course, follow along similar lines.

The value to the farming community of the seed distributed each year would be very much less were it not for the system of seed certification undertaken by the Fields Division. Seed which is distributed by the Pure Seed Station is grown by farmers under certification. This ensures careful inspection of the farmer's crop, and the sealing and tagging of his produce. Ever-widening distribution is thus effected, and full benefit is derived from the nucleus seed distributed each year.

Since each crop offers problems of its own, a few comments on the individual crops will convey an idea of the work accomplished and the major difficulties encountered.

POTATOES.

The potato crop of New Zealand requires annually over 15,000 tons of seed. The position in 1927 was extremely unsatisfactory in that varieties were mixed and many of them wrongly named. The first essential, therefore, was to define varietal differences and clear up a great deal of the misunderstanding that existed. Most of these

difficulties were removed during the first year's work, and to-day the varietal position may be considered quite satisfactory. Constant attention to seed stocks is still necessary, however, if the present standard of varietal purity is to be maintained.

During the same year seed-potato certification was inaugurated and the attendant trials laid down. For the first time was then realized the very great loss experienced by the New Zealand grower as a direct result of virus diseases. Evidence was obtained of the transmission of these diseases from plant to plant in the field and from year to year by means of infected tubers, and thereafter potato selection work was directed more specifically to the isolation and multiplication of relatively virus-free lines.

Since 1927 over one hundred varieties have been grown and studied. The bulk of these proved to be of no commercial value, and by a process of elimination the number of varieties now being grown for distribution has been reduced to twelve. A further twelve are still under trial, their commercial possibilities not having been finally decided. This rapid elimination has been facilitated by the variety trials undertaken by the Fields Division, seed for which was supplied by the Pure Seed Station. A number of importations have been made, and of these Arran Banner has outyielded all other varieties in its class, and has exhibited a wide range of adaptability. This outstanding variety is likely to become extremely popular, and there has been a very heavy demand for seed raised at the Station.

Problems have arisen from time to time during the progress of the work. For example, many potato varieties produce a peculiar form of sport commonly called a "bolter." Such plants are taller, later, and more vigorous, and the tubers are larger and coarser, than those of the variety from which they arise. Bolting has presented a problem because, consciously or unconsciously, growers have sometimes selected these in preference to the parent type. The Epicure crops of New Zealand are dominantly bolters, and it has been necessary in several instances to determine the commercial possibilities of such forms. That they may be of outstanding merit is proved when we consider that Auckland Short-top, which is the most popular variety in New Zealand to-day, is a bolter from Sutton's Supreme. Similarly Aucklander Tall-top, a bolter from Aucklander Short-top, is the latest and one of the heaviest yielding varieties grown in this country.

The problem of raising virus-free seed has developed complications as the work has advanced. Plants affected with virus disease usually exhibit visible symptoms on the foliage, associated with a serious diminution in yield. Aphids transmit certain of these diseases from plant to plant in the field, and infection is maintained from year to year primarily through the use of infected seed. Avoidance of these diseases offers the only solution, and the first step in selection work has been to search for plants that appear free from infection. The produce of these is then multiplied under conditions which will reduce to a minimum the possibility of infection from outside sources.

Leaf-roll is the most common virus disease in New Zealand, and the loss from this cause alone is very serious. Fortunately, avoidance

has proved relatively simple, and the stocks offered by the Station are quite satisfactory in this respect. Mild mosaic has also offered very little difficulty. Despite all precautions, however, by rogueing, and by planting nothing but the produce of what appear to be disease-free plants, a few severely virus-infected plants continue to appear. Certain peculiarities characterize the appearance of these plants. They appear as severely diseased individuals in a crop which is otherwise healthy and vigorous; they arise suddenly from no apparent source of infection; the range is more or less restricted, and the disease is not found commonly in commercial crops; and, finally, only certain varieties are affected.

FIG. I. PORTION OF SEED POTATO AREA AT THE GOVERNMENT PURE SEED STATION.

The crops are examined at regular intervals, and every diseased plant removed as soon as it is observed.

Research workers in potato virus diseases have proved that certain varieties are carriers of infection but do not themselves exhibit any symptoms. This being the case, two apparently healthy varieties growing near one another may be a source of infection to each other, and one or both may exhibit virus disease the following season. Such infection causes, in many cases, a very severe form of virus, which may even result in the death of the plant.

This discovery necessitated a complete revision of the methods being adopted at the Station, and seemed to explain the sudden appearance of virus disease in certain of the lines. Up to this time the practice had been to select large tubers from plants which appeared healthy, to cut each tuber into four parts, and plant these as a tuber unit. Every tuber unit showing signs of disease was at once removed and the remainder harvested. The produce was multiplied in short rows, and from there to larger blocks, until sufficient material was

available for distribution. Dealing with a number of varieties, and growing the tuber units together, later the short rows together, and so on, step by step, it will be realized that ideal conditions were afforded for transmission of virus from one variety to another. With fuller knowledge of the problems relating to the carriers of these diseases, it is now almost certain that the planting system was at fault and had been the cause of virus disease manifesting itself from no apparent source.

The first precaution taken was to grow all tuber units in small isolation plots in a crop of oats. This resulted in such marked improvement as to warrant an attempt to isolate as far as possible one variety from another through each stage of multiplication. The system now adopted is to plant the tuber units and small increase plots of any variety within the larger increase blocks of that variety, situating these plots preferably on the windward side. This ensures that the increase plots are removed as far as possible from any other variety. Moreover, each series of plots is separated from the others by strips of oats or blue lupins, and where the increase block adjoins that of another variety a wide strip of some buffer crop is grown. This is not regarded as completely effective in checking the spread of the disease, but it does in practice afford a check to the migration of those insects which are in a great measure responsible for the distribution of virus.

Despite these difficulties a large quantity of high-class seed has been sold during the last few years. Purchasers have expressed every satisfaction, and last season the Station received orders far in excess of what could be produced, and at a figure well above the current market price. These nucleus lines finding their way to growers who enter their crops for certification is certainly tending to raise the general standard of our potato crops.

The Station also renders a service in growing varieties for identification. Samples are received from all parts of New Zealand. These are grown and reports furnished upon them. To assist in this work, and for educational purposes, a collection of all available named varieties is maintained at Lincoln College, quite apart from the pure seed production at the Station.

WHEAT.

Seventy-five per cent. of the wheat acreage in New Zealand and 85 per cent. of that in Canterbury is devoted to Solid-straw Tuscan. Seed of this variety is remarkably pure. The other varieties, representing 25 per cent. of the wheat area, were for the most part in a very mixed state in 1927. Since then pure lines of all standard varieties have been raised and distributed. Thus an annual supply of pure seed is available. Future work will consist of making, each year, single plant selections within the pure lines, and multiplying these till they reach a sufficient bulk for distribution. It is not intended to develop beyond this stage. All wheat-breeding is undertaken by the Wheat Research Institute, and the part played by the Station consists in maintaining a supply of pure seed of standard varieties or of new varieties raised by the Institute.

Natural crossing in wheat has presented a difficult problem. Wheat is normally self-pollinated and therefore it should be possible for two varieties to be grown in adjoining plots without serious danger of crossing. In Canterbury hot winds at pollinating time are probably responsible for the flower opening either earlier or to a greater extent than is normally the case, and receiving pollen which is liable to be scattered some distance under these conditions.

It has been shown that natural crossing decreases very rapidly as the distance between the varieties is increased. The somewhat extensive cross-pollination that has been observed from time to time in the pure lines has undoubtedly taken place in the nursery rows, when varieties have been grown in close proximity to one another. To overcome this danger all nursery rows and small increase plots

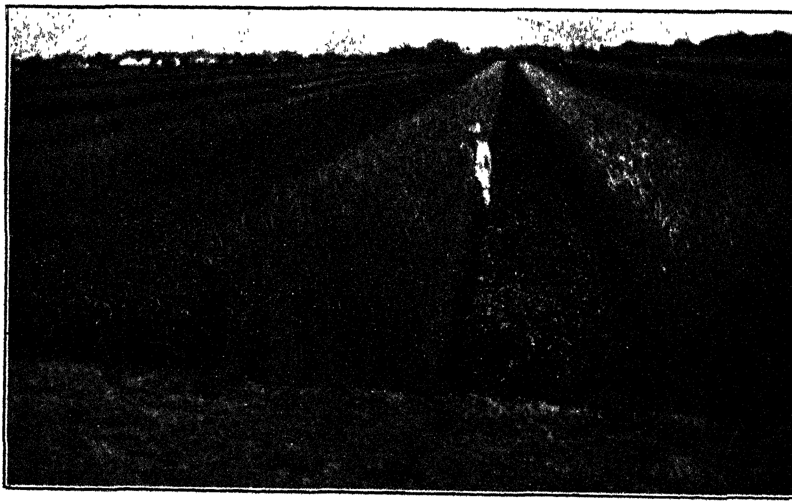

FIG. 2. SEED WHEAT PLOTS AT THE STATION.

Between each plot is a belt of rye-corn, which, being taller than the wheat, helps to prevent cross-pollination of the varieties.

of any one variety are now grown in the centre of the main block of that variety. Thus any natural crossing is almost certain to be within the variety. Where the boundary of one variety meets that of another a belt of rye-corn 12 ft. wide is grown. This attains a greater height than the adjoining wheat and, by arresting wind-borne pollen, is sufficient to render negligible any intervarietal crossing.

The control of covered smut has offered no difficulty. Loose smut, on the other hand, has proved more difficult to control than was at first anticipated. The Station is indebted to the Canterbury Seed Company, Christchurch, for undertaking the hot-water treatment of all seed wheat. With few exceptions this has resulted in smut-free crops. Occasionally, however, a small source of infection has been overlooked. In one instance a few infected

heads developed in a plot of wheat 20 chains distant, and the following season a number of varieties were observed to be infected.

The timely realization of the possibilities of such a wide distribution of spores enabled extra precautions to be taken, one of which is that all seed sown in the final increase blocks is hot-water treated, ensuring that seed wheat distributed by the Station is never more than once removed from treatment. Apart from the small risk of outside infection during the growing season, this ensures the distribution of smut-free seed.

PEAS.

The area annually devoted to the production of peas in New Zealand fluctuates between 10,000 and 20,000 acres. The crop is practically confined to Canterbury and Marlborough.

Certain of our merchants specialize in the production of garden peas, which are grown on contract with farmers. Since the seed is generally supplied to the grower under a code letter or number, he is not particularly interested in the matter of purity and correct nomenclature. The merchant, on the other hand, is vitally concerned with varietal purity. Few seeds are subject to such close scrutiny, and a high standard has to be maintained or very serious consequences may result. Impurities may be introduced during threshing, harvesting, and seed-cleaning; but, quite apart from these causes, off-type plants or "sports" arise and multiply very rapidly unless discovered in the field and removed. The occurrence of these impurities necessitates rogueing in the field, and men are employed to walk up and down the crops to remove all rogue or off-type plants. Rogueing is very expensive, and is not as effective as might be desired.

The selection work at the Station has a twofold objective. It is desired, firstly, to raise pure lines as nearly characteristic of the variety as is possible; and, secondly, to sell to merchants each year a few sacks of pure seed of each of the more important commercial varieties.

The first objective is not as simple as it might appear. Difficulty was experienced in arriving at the true types representative of certain of the more popular varieties. For example, single-plant selections from such varieties as Daisy and Stratagem varied considerably, and no standard could be obtained upon which to base selection. This indecision resulted in considerable delay, and in some cases divergent types have been maintained pending a decision. Thanks to the co-operation of merchants, practically all these lines are being grown, both in New Zealand and England, by those well versed in trade requirements, and their criticisms will be invaluable in arriving at a decision as to which lines to retain and which to discard.

The second objective is really a commercial one. Merchants supply stock seed to growers, and after a few years it reaches a state of impurity that necessitates rogueing. Were merchants to procure annually a few sacks of pure seed they would be able to multiply and distribute this to their growers. Since each year

under this scheme they would have pure seed coming forward, they would be in a position to discard stocks which had become impure, and in this way avoid, wholly or in part, the expensive operation of rogueing. Preliminary selections were made in 1928, and this season pure stocks of about thirty varieties are being grown. It is hoped to make contracts this season for delivery in 1933–34, and several merchants have indicated their intention to procure seed from the Station.

Selection work in field peas was also commenced in 1928. After preliminary trials numerous lines were isolated from the standard varieties. These have been placed under trial each year, and by a process of elimination the number has been so reduced that during the last two seasons careful yield trials have been possible. Progress has been slow, partly because of seasonal conditions and partly on account of inadequate knowledge of those characters upon which to base selection. For example, the Partridge pea is the most important variety, and is grown either for seed which is consumed in this form, or as a fodder or green manure. For the former purpose certain seed characters are desirable, and also a heavy yield associated with the minimum of haulm. For fodder and green manure purposes bulk is of importance, and seed yield, though desirable, is not so essential. Two specialized types, rather than one with a dual purpose, seem to be desirable. Blue Prussians, White Ivory, and Marrowfat peas are also receiving attention, and some very promising selections have been made.

LINSEED.

The Moose variety of linseed is an introduction from Algeria, known there under the name of Lin de Safi. It has been grown for a number of years in New Zealand, and the yields have proved satisfactory and the content of oil appreciably higher than that of the commonly grown variety. It has, however, a very short straw, which renders harvesting with the reaper and binder very difficult. A number of selections were therefore made of tall plants growing in commercial crops. By this simple means tall strains have been isolated, and these are now undergoing final yield trial and analysis to determine which should be retained for increase.

Numerous varieties have also been introduced, but now, after several years' trial, all but a few of the most promising have been discarded. These few are being included in the current season's trials.

CONCLUSION.

It takes several years to establish work of the kind described, but results are now forthcoming and fully justify the establishment of the Pure Seed Station. It will be still further justified as additional crops are added to the programme of work. Objectives which at one time were somewhat nebulous have assumed more definite form, and the work will progress along surer lines in the future. The purpose of this review will have been attained if it brings the Station and its objectives under the effective notice of farmers, merchants, and those engaged in agricultural instruction.

OFFICIAL HERD-TESTING OF PUREBRED DAIRY COWS.

SUMMARY OF THE SEASON'S WORK, 1931-32.

W. M. SINGLETON, Director of the Dairy Division, Wellington

THE Official Herd Test has now completed its fifth year of operation, and at the close of the year under review—30th September, 1932—some 8,856 cows had been tested under this system. Under ordinary circumstances a survey of the five years' results would have been interesting, but the abnormal conditions experienced during the past two years or so tend to make such a review practically valueless.

So far as the past year is concerned, the position must be considered satisfactory, as, while there was a falling-off, the proportion of O.H.T. breeders and tested cows to number of entries in the parent system, the Certificate-of-Record Test, was more than maintained. For the twelvemonth ended 30th September last 1,798 cows were tested under the O.H.T. system, these being in the herds of 160 of C.O.R. testing breeders. This represents a decrease of 438 cows and 15 breeders from the 1930-31 year. All breeds, and particularly the Friesians, showed a decided falling-off, the only breed to improve its position being the Milking Shorthorn.

The accompanying tables are compiled on the basis of all cows on test for six months (180 days) or more, which has proved to be the most satisfactory classification, the O.H.T. being a ten-months test. Cows other than registered purebreds are omitted from the

Table 1.—Official Herd-testing in Two Past Seasons on Basis of all Cows on Test for 180 Days or more.

Breed.	Number of Breeders.	Number of Cows.	Average Yield for Season.		
			Days in Milk.	Milk.	Butterfat.
Season 1930-31.					
				lb.	lb.
Jersey	134	1,187	283	5,851·7	314·26
Friesian	27*	632	274	8,256·8	286·42
Ayrshire	3	42	273	6,705·0	266·45
Milking Shorthorn ..	5	128	257	5,789·5	231·09
Red Poll	1	19	268	5,168·2	206·14
Totals ..	170	2,008	278	6,617·4	298·17
Season 1931-32.					
Jersey	121	998	284	5,704·2	307·73
Friesian	20*	279	274	7,518·2	262·92
Ayrshire	4	37	260	6,462·3	273·96
Milking Shorthorn ..	11	174	274	6,039·7	243·41
Red Poll	2	18	268	4,926·3	204·57
Totals ..	158	1,506	280	6,088·4	289·94

* One Friesian breeder also testing Jerseys.

Table 2.—Average Production in Classes and Breeds for all O.H.T. Cows.

Class.	Season 1930–31.				Season 1931–32.			
	Number of Cows.	Average Days.	Average Milk.	Average Butterfat.	Number of Cows.	Average Days.	Average. Milk.	Average Butterfat.
				Jersey.				
			lb.	lb.			lb.	lb.
Two-year-old and under	488	282	5,111·8	275·65	403	286	5,126·8	277·24
Three-year-old	174	274	5,708·9	310·32	191	283	5,774·6	315·63
Four-year-old	159	286	6,434·7	350·37	130	286	6,226·7	337·93
Mature	366	287	6,652·6	351·92	274	282	6,256·6	332·76
				Friesian.				
Two-year-old and under	207	280	6,978·3	246·14	85	280	6,116·9	217·61
Three-year-old	106	269	8,196·8	287·79	60	273	7,763·3	270·02
Four-year-old	88	266	8,394·6	291·46	40	275	8,035·6	281·13
Mature	231	273	9,377·5	319·96	94	268	8,408·8	291·60
				Ayrshire.				
Two-year-old and under	2	263	5,246·4	223·16	9	234	5,649·5	220·96
Three-year-old	13	273	6,634·6	258·71	2	233	5,522·2	241·66
Four-year-old	8	264	6,949·0	272·09	11	256	6,754·0	275·49
Mature	19	277	6,936·6	273·92	15	280	6,861·5	308·93
				Milking Shorthorn.				
Two-year-old and under	42	258	4,560·2	184·80	53	275	4,850·2	198·83
Three-year-old	20	266	5,781·2	240·01	34	268	5,753·4	231·67
Four-year-old	11	256	6,922·9	274·86	19	273	6,600·1	267·96
Mature	55	253	6,504·5	254·44	68	277	6,953·4	277·16
				Red Poll.				
Two-year-old and under	5	275	4,452·1	198·17	8	283	4,937·4	199·05
Three-year-old	6	265	4,729·5	187·82	6	239	4,538·0	196·09
Four-year-old	5	271	6,019·3	224·81	3	274	5,321·7	225·66
Mature	3	261	5,820·7	225·01	1	299	5,980·3	236·34

tables, although each year a number of these are tested by special arrangement where no other organized system of testing is reasonably available or where the unregistered cows form only a small proportion of the herd. Some 95 cows came under this heading, while 186 registered purebreds and 11 other cows were, for various reasons, withdrawn from test prior to 180 days and consequently did not qualify for inclusion in the tables.

Table 1 is a production table, according to breed. In view of the unfavourable climatic conditions, an average yield of 289·94 lb. of butterfat must be considered satisfactory in comparison with the preceding year's average of 298·17 lb. Both Ayrshires and Milking Shorthorns show increases, the latter breed having improved its position very creditably in both average production and number of cows tested.

In Table 2 the production averages are given under age classes within the various breeds, the previous year's figures being included for purposes of comparison.

It is interesting to compare the O.H.T. results with those for ordinary factory-supply herds. New Zealand's average tested cow for last season, including all cows in milk 100 days or more, yielded 236 lb. butterfat in 253 days. The O.H T. average on the same basis was 280·12 lb. in 271 days, while the C.O.R. 305-day test average was 421·09 lb., and the 365-day test 495·17 lb.

WOODLANDS FELICIE QUALIFIES FOR CERTIFICATE OF RECORD.

THE Jersey cow Woodlands Felicie, whose world record performance was reviewed in detail in the *Journal* for September last, calved subsequent to test on 2nd November. The calf is a heifer, born 441 days after the dam's date of calving for commencement of test. Thus Woodlands Felicie has now fully qualified for her first-class Certificate of Record, the maximum period allowed for calving under the rules for the first class being 455 days. Woodlands Felicie had her first calf on 30th August, 1928, and her succeeding dates of calving were 8th October, 1929, 12th July, 1930, 19th August, 1931, and now 2nd November, 1932. In addition, therefore, to being a wonderful producer of butterfat Woodlands Felicie has been a consistent breeder. It may be again mentioned that her final figures for the 365 days on test were 1,220·89 lb. of butterfat from 17,332 lb. of milk, and that the test was commenced at the age of 4 years 364 days.

As previously stated, Woodlands Felicie is owned by Mr. P. J. Petersen, of Brixton, Waitara, Taranaki. While this cow's productive ability has been amply demonstrated by her world record performance, it is obvious that she has received kindly and skilful treatment. Our congratulations are extended to Mr. Petersen.

—*Dairy Division.*

SCLEROTIUM-DISEASE *(SCLEROTINIA SCLEROTIORUM)* OF TOMATOES.

ITS APPEARANCE, CAUSE, AND PREVENTIVE TREATMENT.

E. E. CHAMBERLAIN, Mycological Laboratory, Plant Research Station, Palmerston North.

SCLEROTIUM - DISEASE (also variously known as sclerotinia - disease, sclerotial-disease, stalk-disease, &c.) is in New Zealand a serious disease of tomatoes, especially of those grown out of doors. The disease is of world-wide distribution, and has been recorded as occurring on tomatoes throughout Europe, North America, and Australia. It was recorded as occurring on tomatoes in New Zealand by Kirk (1906), who in the same year also recorded it on potatoes, beans, and chrysanthemums.

SYMPTOMS.

The first sign of sclerotium-disease is usually a sudden wilting of the plant when it is in the four or five truss stage—*i.e.*, just as it is coming into bearing. At some point below where the plant is wilted a light-coloured portion of the stem may be seen (Fig. 1). This pale-coloured area marks the limits to which the causal organism has penetrated.

Under New Zealand conditions infection usually takes place at the nodes and at some distance above the ground-level. Occasionally, however, the plants are infected at the ground-level. The disease spreads rapidly through the tissues, blocking the vessels and cutting off the water-supply, with the result that the plant wilts and soon dies. This disease is typically a disease of the stem, and the causal organism confines its attack to this part of the plant, the leaves being killed merely by starvation.

On splitting open the discoloured portion of the stem it is found to be lined with irregularly shaped black bodies ranging in size from that of a grain of wheat to that of a pea (Fig. 2). They are hard and tough, and on being cut are seen to be white inside. The presence of these black bodies within the stem is the most characteristic feature of the disease. Any fruit which is already formed at the time of the attack shrivels up. In normal seasons when the attack is not severe it is usual to find infected plants scattered here and there throughout the field, but when the disease is prevelant infection usually occurs in patches.

ECONOMIC IMPORTANCE.

Sclerotium-disease occurs in both North and South Islands, and has been recorded from every district where tomatoes are grown. It is one of the most serious diseases attacking tomatoes in this country. A small proportion of plants are attacked every year, while in certain years it occurs in epiphytotic form. It is of sporadic occurrence, being prevalent in one district while in a neighbouring district very little of the disease may be present. It occurred in epiphytotic form on various hosts in the years 1919, 1923, and 1927, being particularly severe on tomatoes in 1923.

The plants attacked are killed, and as a rule the attack takes place too late in the season to allow of a profitable replacement with fresh

FIG. 1. SCLEROTIUM-DISEASE ON TOMATO PLANT.

Light-coloured area indicated by arrow shows the point of attack by the fungus at a node.

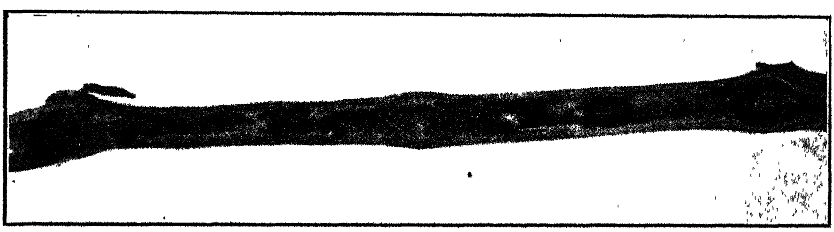

FIG. 2. SCLEROTIA LINING THE PITH CAVITY OF A TOMATO STEM.

[*Photos by H. Drake.*

plants. Although sclerotium-disease is more serious among outdoor tomatoes, it may become quite a serious problem in the glasshouse. Over 30 per cent. of infection was recorded in one glasshouse in Christchurch in 1923. The disease is more severe in unheated than in heated houses.

Host Range of the Causal Organism.

This disease is not confined to tomatoes, but attacks a wide range of plants. In other countries it causes serious losses among many crops, and is also responsible for serious storage rots. It is one of the most serious diseases occurring on garden crops in this country and is particularly severe among artichokes, lettuce, and potatoes. Cunningham (1927) gives the following list of plants attacked by the causal organism in New Zealand: Antirrhinum (cultivated), artichokes (Jerusalem), bean (broad or Windsor, butter, French, horse, soya), brassicas

(chou moellier, cabbage, kale, rape, swede, and turnip), carnation, Cape gooseberry (*Physalis peruviana*), Canadian thistle (*Cnicus arvensis*), carrot, celery, cucumber, curled dock (*Rumex crispus*), dahlia (cultivated), fat-hen (*Chenopodium album*), fennel (*Foenicilum vulgare*), lettuce, lemon (fruits and shoots), mangold, melon, potato, pea, parsnip, pelargonium (cultivated), passion-fruit, spear thistle (*Cnicus lanceolatus*), sweet-pea, sunflower, spinach, tomato, tree mallow (*Lavatera arborea*), tree tomato (*Cyphomandra betacea*), tulip, and wing. thistle (*Carduus pycnocephalus*).

Brien (1932) has made the following additions to this list: Apple (fruits in cool store), bitter cress (*Cardamine heterophylla*), blue lupin, larkspur, lucerne, marrow, milk thistle (*Silybum marianum*), orange (fruits), pear (fruits), pumpkin, radish, sow thistle (*Sonchus oleraceus*), tobacco, wallflower, and zinnia.

LIFE HISTORY OF THE CAUSAL ORGANISM.

The causal organism is the same as that described by Cunningham (1927) as causing a disease of Jerusalem artichokes—namely, *Sclerotinia sclerotiorum* (Lib.) Mass., an organism which has in North America been usually named *S. Libertiana* Fcl.

Doubt exists in literature as to the mode of infection by this fungus. Working on this disease de Bary (1886: 1887) came to the conclusion that it was necessary for the fungus to pass through a previous stage as a saprophyte before it could function as a parasite. Pethybridge (1911) showed that although the spores were not able directly to attack normal healthy leaves of potatoes, they were able to attack leaves which had begun to yellow off. Field observations indicate that this is the case with both potatoes and tomatoes under the conditions existing in New Zealand. That the fungus may directly attack healthy tissue has been shown by successful inoculations of the stems of healthy tomato and potato plants with portions of sclerotia and with mycelium secured from culture.

The life history of *S. sclerotiorum* has been described by Pethybridge (1910: 1911) and its mode of infection by Boyle (1921). Given sufficient moisture the spores of the fungus germinate and send out germ tubes. If any of these germ tubes come in contact with a yellowing leaf they send out narrow infection hyphæ, which are capable of rupturing the cuticle by mechanical means and entering the leaf. If, on the other hand, the germinating spore is not in the vicinity of a yellowing leaf the germ tubes either do not develop beyond the rudimentary stage or, if they are in the presence of decaying organic matter, they form a saprophytic mycelium. This saprophytic mycelium is capable of forming infection hyphæ which can penetrate and infect any tomato leaf or stem with which they come in contact. Field observations show that in many cases infection occurs from the fungus growing in the soil, for it has been noticed that leaves touching the ground at their tips often become infected. Moreover, occasional plants become infected at the ground-level, and in these cases the infection has probably occurred from the fungus in the soil.

Having gained entrance to the leaf the hyphæ develop a mycelium which rapidly spreads through the leaf and down the leaf petiole to the stem. The fungus rapidly girdles the stem, disorganizing the

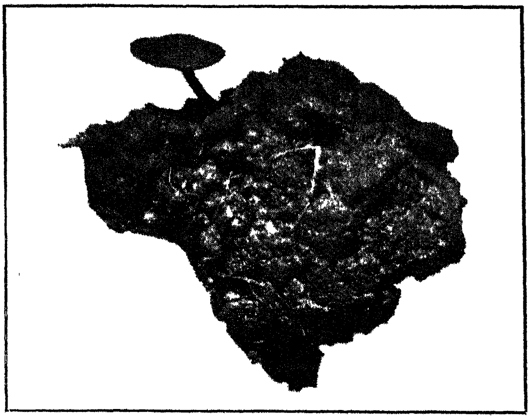

FIG. 3. APOTHECIUM OF SCLEROTIUM-DISEASE × 1½.

Collected from the field and showing the apothecium growing from a sclerotium embedded in the soil.

FIG. 4. APOTHECIA PRODUCED IN CULTURE GROWING OUT FROM SCLEROTIA × 1½.

[*Photos by H. Drake.*

tissues and preventing the passage of water, with the result that the plant wilts. Not only does the fungus kill the outer portions of the stem but it penetrates to the interior, where it replaces the pith with a white mycelium. Portions of this mycelium become compacted into closely interwoven dense masses of hyphæ (sclerotia), which ultimately line the pith cavity (Fig. 2). They are at first white, but finally turn black at the surface. If the conditions are very humid they are also formed on the outside of the stem.

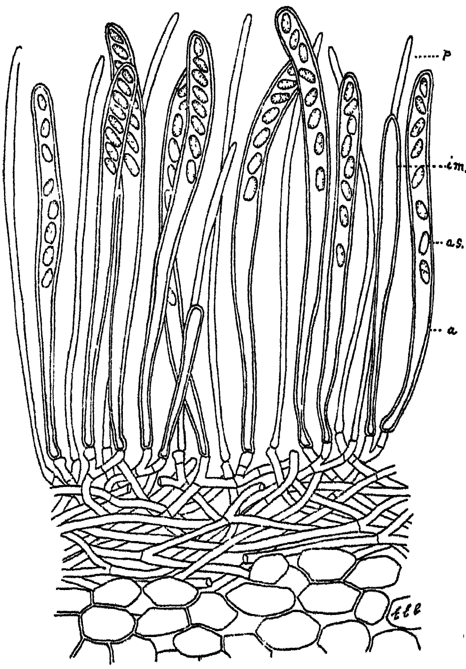

FIG. 5. SECTION THROUGH APOTHECIUM × 430.
(*a*) Asci; (*im.*) immature ascus; (*as.*) ascospores; (*p*) paraphyses.
[*Original.*

When the plant dies down the stems rot away and the sclerotia find their way into the soil, where they are capable of remaining viable for at least two years (Baribeau, 1923). Under New Zealand conditions the sclerotia kept in a dry state were found to be viable after two years and a half. In the spring and early summer, under suitable conditions of temperature and humidity, they will germinate and produce light-coloured, stalked, cup-shaped bodies termed apothecia (Figs. 3 and 4). On the upper surface of these bodies occur long cylindrical sacs (asci) each of which contains eight spores (ascospores) (Fig. 5). These spores are ejected from the apothecia and may be carried by the wind to neighbouring plants and soil. The apothecia are produced over a period of several months, and the spores may remain viable for as long as forty-five days (Lobik, 1928).

FACTORS AFFECTING INFECTION, GROWTH, AND SPREAD OF SCLEROTIUM-DISEASE.

As with most fungi, moisture is essential for the germination of the spores. Infection may take place either through the yellowing leaves or from the soil in close proximity to the plants, so that only those spores germinating in these positions are significant in spreading the disease. The older leaves yellow off first, so that high humidity at the base of the plants will not only encourage germination of and infection by spores on the surface of the ground but also of those on the leaves. High humidities are mainly due to the prevailing climatic conditions, but are considerably influenced by close planting, the presence of weeds and other cover on the surface of the ground beneath the plants, and by the presence of abundant foliage at the base of the plants.

Apothecia develop only under conditions of favourable soil temperature and humidity. Compacted soil and the presence of cover on the surface tend to raise the soil humidity, and it is very noticeable that it is under these conditions that apothecia are usually formed. They are rarely formed on well-cultivated friable soil, since a compacted soil with a resultant high moisture content in contact with the sclerotium is necessary for its germination. Sclerotia occurring on the headlands readily produce apothecia under cover of grass and weeds. Not only is high humidity necessary for the production of apothecia and for infection by the spores, but it also produces a much more rapid growth of the fungus within the tissues. If the conditions are very humid an increased number of sclerotia are formed, for they are then produced on the outside of the stem as well as inside.

The optimum temperature for the growth of the fungus is not high, and its attack is most severe between 60° and 70° F. (Weber and Foster 1928). Thus the disease is more common and more troublesome in unheated than in heated glasshouses.

The spores of the fungus are ejected from the apothecia for some distance into the air, and may be carried considerable distances by the wind. Thus a garden may be free from sclerotia and apothecia and still become infected from neighbouring fields. Smith (1931) considered that under the conditions existing in California the spores were always present, whether any apothecia occurred in the field or not, and that infection depended solely on climatic conditions. Although it is not probable that the spores are quite so numerous in New Zealand, it may readily be seen that it is dangerous to leave infected plants bearing sclerotia lying about the headlands or on rubbish heaps in or near the gardens.

Not only is there a danger of the disease being carried over from one season to the next by sclerotia from an infected tomato crop, but the sclerotia formed on any one of the numerous susceptible hosts may also serve as a source of infection. In this connection the growing of blue lupins for green manuring may become a factor in spreading the disease. Blue lupins are susceptible to the attack of sclerotium disease, and where it is present in the crop the seed often becomes infected and in some cases the seeds are actually replaced by sclerotia

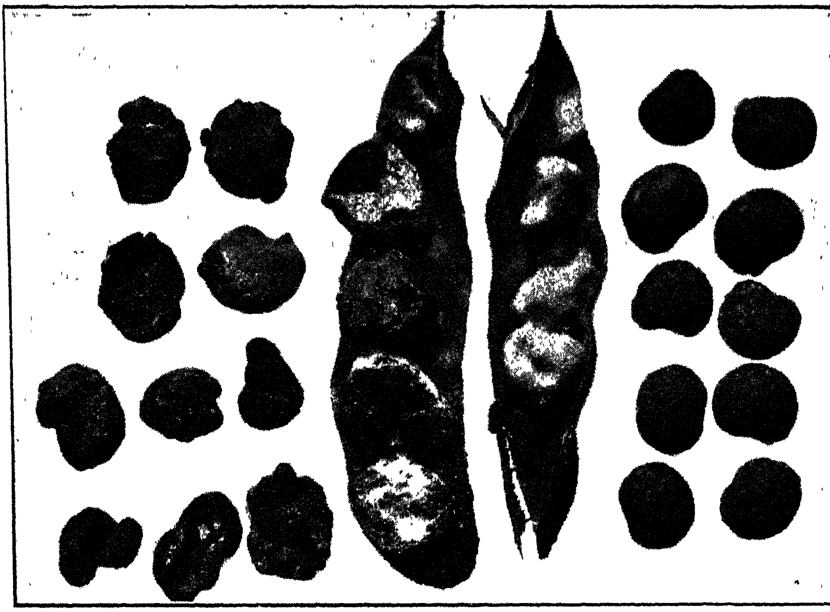

FIG. 6. LUPIN SEEDS REPLACED BY SCLEROTIA WITHIN THE PODS.
[Photo by H. Drake.

(Fig. 6). Thus there is a possibility of introducing the disease into a garden when this cover crop is used. The disease is also carried in the seed of sunflowers and on the tubers of artichokes.

PREVENTIVE MEASURES.

From the foregoing it may be seen that infection is brought about by the ascospores, so the obvious method of checking the disease would appear to be by killing the spores. Since the apothecia may be produced by sclerotia in any part of the garden, or even in a neighbouring garden, it is not possible to destroy the spores at their seat of origin. It is reasonable to suppose that infection through the yellowing leaves might be prevented by spraying, but even if this could be accomplished infection from the soil could not be controlled by this means. Pethybridge (1916) showed that spraying with bordeaux, lime-sulphur, or milk of lime had no effect on the incidence of the disease on potatoes. It may be concluded that sprays cannot be satisfactorily used against sclerotium-disease.

Since it does not seem to be possible to actually destroy the spores an attempt must be made to prevent the introduction of the disease into the garden, or, once it is there, to prevent the development of apothecia. The disease may in many cases be introduced into a garden by air-borne spores, and this type of infection cannot be prevented. It is not feasible to destroy the sclerotia present in the soil of a garden, since any treatment which would kill the sclerotia would be too expensive to apply.

Although crop rotation may help in keeping down infection, it must be remembered that the planting of tomatoes on clean land does not ensure freedom from infection if sclerotia are present in an adjacent field.

Control in the Field.—The plants should be well spaced and a judicious pruning of the lower leaves practiced. The lowering of the humidity resulting from the greater air circulation and better penetration of the sun's rays will check germination of the spores, and consequently lower infection. The ground between the plants should be well worked and all weeds and other cover removed. This will also aid in keeping down the humidity, and the loosening of the soil will prevent the development of apothecia. Thorough cultivation is one of the most important factors in keeping down infection by this fungus.

Care should be taken to see that the disease is not introduced into the garden in infected seeds, and particular care should be taken when securing lupin seed for growing as a cover crop. The seed may be tested by throwing a few handfuls of it into water, when the sclerotia and the seed bearing sclerotia will float to the surface. Any suspicious bodies may be tested by cutting, when the fact that the sclerotia are white inside serves to distinguish them from other foreign bodies. When growing lupins the plants should be examined for the presence of the disease before they are dug in.

All diseased plants should be removed immediately they are seen, and care should be taken that no sclerotia are allowed to fall to the ground. The infected plants should be burnt and not piled up in rubbish heaps or left on the headlands, as the sclerotia are then in an ideal position for the production of apothecia. Not only is it necessary to destroy all the diseased tomato plants, but also the infected plants of any other crop.

Control in the Glasshouse.—Sclerotia in the soil may be killed by steam sterilization, and this is the method recommended for sterilizing the soil in an infected glasshouse. It is also advisable to sterilize all soil which is being introduced into the house. Where steam sterilization is not possible the soil of an infected house should be removed and replaced with clean soil. When resoiling the glasshouse the soil should not be taken from a garden where plants susceptible to the disease have been growing. The best practice is to obtain the soil from a field which has been down in grass for a number of years.

As in the field, the lower leaves of the plants should be pruned and the soil well cultivated. The humidity should be kept down by giving as much ventilation as possible consistent with the maintenance of an even temperature. The watering, which should not be excessive, should be carried out in the morning, and as far as possible on fine days only. Water should not be allowed to lie on the surface of the ground, for if sclerotia are present surface water will tend to bring about apothecia formation. Directly the disease is seen in the house all infected material should be removed and destroyed.

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WIRE-BRACING OF FRUIT-TREES.

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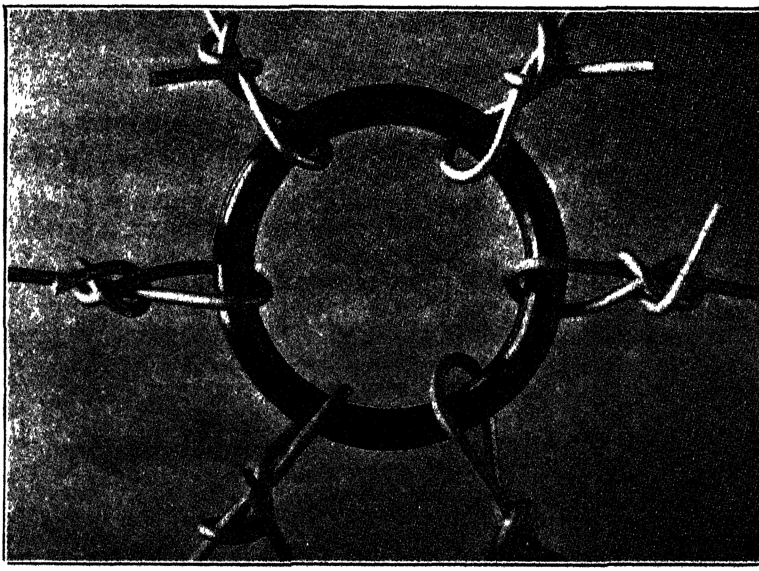
WIRE-BRACING for the support of limbs in fruit-trees is rapidly increasing in popularity in New Zealand and elsewhere, and is proving more satisfactory than wooden props and less costly. It is intended in this article to explain several of the different systems, and to make a comparison between "central" wire-bracing and the use of props.

One of the first systems brought into use in commercial orchards is known as the "cross" system of wire-bracing, and consists of connecting limbs on either side of a tree by a single strand of wire. The wire may be connected to the limbs in a number of different ways, such as (*a*) driving a staple into the side of the limb facing the centre of the tree and at the desired height, the wire being fastened to the staple; (*b*) inserting a screw-eye instead of a staple; (*c*) placing the wire round the limb and preventing it cutting into the bark by the use of a metal clip manufactured for the purpose, or by threading on to the wire a small length of old spraying hose, or using a piece of old motor-tire, &c.; and (*d*) boring a hole through the limb slightly larger than the diameter of the wire to be used, and after threading the wire through the hole turning the end back with pliers and again inserting it a small distance into the hole, the bulge made in bending the wire being thus too great to be drawn back.

While this system of wiring gives satisfactory results in some cases, it is not suitable to all trees, particularly trees that have a much more vigorous growth on one side than on the other, in which case the weakly branches are often pulled up into the centre of the tree through

lacking sufficient strength to support the larger limbs. Trees that have more limbs on one side than on the other also present difficulties in using the " cross " system of wiring.

The " circle " wiring-bracing system finds favour with a number of orchardists, and consists in placing a wire around each tree at the most desirable height, the wire being prevented from injuring the bark in the same way as in the " cross " system. One of the weaknesses of this method is that many limbs require support at a different height from the ground to others, which results in the shorter and weakly limbs being given a bowed effect, while the extra tall limbs are inclined to break off at the level of the wire.



SHOWING PROPER METHOD OF FASTENING WIRES TO RING IN CENTRAL BRACING SYSTEM.

This figure 8 tie is quick to make and is not liable to pull out like an ordinary twist.

The " central " wiring system has distinct advantages over the other two described. In this system each limb is supported by a wire, one end of which is attached to the inner side of the limb by means of a screw-eye or staple ; the other ends of the wires come together in the centre of the trees where they are attached to a single ring which is supported by the various wires. Rings suitable for this purpose are japanned malleable iron harness-rings, with a diameter of 2 in. and thickness of iron $\frac{1}{4}$ in. Large-sized washers could also be used. Screw-eyes that have been found suitable for limbs varying in diameter from 1 in. to 3 in. have a total length of $1\frac{1}{2}$ in. ; the " eye " should be $\frac{3}{4}$ in. (outside measurement) and the thickness of metal about $\frac{5}{32}$ in. For fastening the individual wires to the limbs a staple is very often used, the size varying according to the size of the limb. However, the

staple is more likely to split the branch than a screw-eye and thereby increase the risk of either pulling out or the limb breaking off under the weight of a heavy crop.

Any means of fastening which necessitates the wire encircling the limb should be avoided on account of the trouble in preventing the wire cutting into the bark as the diameter of the limb increases. Screw-eyes varying in size according to the diameter of the limb are therefore to be preferred, and should be screwed in until the shoulder of the eye meets the bark. The eye should be left parallel with the limb rather than crosswise, for if left crosswise it is liable to restrict the flow of sap in later years. Tall and slender limbs will in some instances require to be supported by two wires, both of which can readily be fastened to the centre ring. In other instances some of the smaller limbs are most economically fastened to the larger limbs.

While wiring can be done at any time of the year, the most suitable time is immediately after the winter pruning has been completed. At this time the limbs are not pulled out of position by the weight of fruit, there is no foliage to restrict vision or young shoots that are readily broken, and the rush of work is not usually so great as later in the season.

Central wire-bracing has the following advantages over wooden props: The bracing is practically permanent, lasting, it is estimated, at least twenty years; it can be done at almost any season of the year; the cost of material is cheap and depreciation very low; it does not interfere with picking and carting of fruit, spraying or cultivation; the strain on any one limb is supported by all limbs, and the limb is secure during any storm.

The principal disadvantages of wooden props are high cost and high depreciation; inconvenience caused in picking and carting the fruit, interference with cultivation and spraying, and frequent dislodgement by wind, &c., allowing the branch to break.

For the purpose of making a comparison between the cost of central bracing and props the following figures have been worked out, which, it is believed, give a fair and reasonable estimate. While prices may vary considerably in different districts, the quotations (secured in June, 1932) afford a basis for estimating the cost of materials.

Estimated Annual Cost per Propping of 100 Trees, allowing Support for Ten Limbs per Tree.

	£	s.	d.
1,000 manuka props 6 ft. to 8 ft. long at £2 10s. per 100, allowing life of props at 5 years (cost per year)	5	0	0
Placing in position each year (labour)	2	0	0
Annual removing from orchard and stacking (labour)	1	0	0
Total	8	0	0

Estimated Cost of Central Wire-bracing per 100 Trees, allowing Support for Ten Limbs per Tree.

	£	s.	d.
100 harness rings at 15s. per gross	0	10	6
1,000 galvanized screw-eyes, 1½ in., at 4s. per gross	1	7	9
Galvanized wire, 14 gauge, at 4 ft. per limb, reckoning 6,560 ft. per cwt. and wire at 30s. per cwt.	0	18	3
Labour required to secure screw-eyes and wires to 100 trees, assuming that one man at 12s. per day can wire 24 trees	2	10	0
Total initial cost of wiring	5	6	6

Assuming that the life of a wiring system is but twenty years, the initial cost would therefore amount to only 5s. 4d. per year. However, additional wires will need adding, and the position of existing wires altered in certain trees every year. If it is taken that one extra wire is added to each tree each year this extra material and labour would increase the annual cost by about 10s. 8d., making the total annual cost per 100 trees 16s., as compared with £8 when wooden props are used.

Further matters that must be taken into consideration when making a comparison between the two systems of tree supports are the loss of fruit as a result of the use of wooden props. It is far from uncommon for a number of props to be displaced every year, while supporting heavily laden limbs, by strong wind and many other causes. This displacement frequently results in a broken limb. Also limbs not infrequently break off at the point of contact with the prop. To estimate the loss from such limb breakages suppose that one limb on every tenth tree, carrying an average of 1 bushel of fruit, breaks each season. This limb will take about five years to replace, during which time the new branch will yield about 1½ bushels of fruit, compared with five cases if the limb had not broken. At this rate in five years there will be fifty broken limbs in every 100 trees, with an average annual loss of 175 bushels of fruit. Valuing this fruit at 1s. 6d. per bushel the annual loss is £13 2s. 6d.

Sun scald is the cause of considerable loss of apples in many districts. The loss of fruit in this way is in many seasons practically confined to fruits in the centre of trees which are suddenly exposed to the direct rays of the sun as a result of limbs being borne outwards by the weight of fruit. This trouble does not occur in trees that are securely wire-braced. If it is assumed that the annual loss from sun scald is one-sixth of a bushel per tree the loss from 100 trees at 1s. 6d. per bushel would amount fo £1 5s.

There is a tendency with all trees regularly carrying heavy crops for the limbs to gradually become more and more horizontal, even during the dormant season, and it is not uncommon for a considerable number of limbs in most orchards to have to be removed or considerably shortened every pruning season on account of being in the way of cultivation and other orchard work. The loss of limbs in this way would be about as great as that caused by limbs breaking, consequently a further quantity of fruit to the value of £13 2s. 6d. is annually lost to the grower.

It is common knowledge that the more horizontal a branch becomes the more the growth is retarded, also the more vertical a limb the more vigorous will be the growth. The main limbs of most heavy bearing varieties are invariably prone to assume a more horizontal position each year. This undesirable tendency is either rectified or prevented, as the case may be, where a permanent system of tree support is employed.

There is one, and one only, consideration in favour of the use of wooden props—namely, that with this system of tree support a far greater proportion of the crop can be harvested without the use of ladders. However, this advantage is more than offset by the inconvenience caused by the props interfering with the various orchard operations.

The monetary gain per annum on every hundred trees by the use of the central system of wire-bracing compared with the use of wooden props, may be summarized as follows:—

	£	s.	d.
Difference between cost of props, plus labour, and cost of wiring material, plus labour	7	4	0
Saving of loss through broken limbs	13	2	6
Saving of loss caused by sun scald	1	5	0
Saving of loss through limbs being shortened back	13	2	6
Total saving	34	14	0

UTILIZATION OF NATURAL HEAT RESOURCES IN THERMAL REGIONS.

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THE object of this article is to give in brief outline a few of the recent developments in the utilization of subterranean heat, with a view to emphasizing the great possibilities of this source of natural energy. When the world-wide occurrence of thermal activity is taken into account it is surprising to find that, so far as is known to the writers, there are only three localities in the world where any noteworthy interest has been taken in harnessing this latent heat energy; these are Tuscany (Italy), California, and Iceland.

In the last-named country "earth heat" is not regarded as a luxury, but as a necessity, for here volcanic activity has provided abundant areas of heated soil, making possible the cultivation of crops normally grown only in more temperate regions. Moreover, steam from the hot springs is adapted to the heating of homes and to the provision of hot water for both baths and laundries. Recently, despite the disadvantages of an exceptionally cold climate, the enterprising Icelanders have built glasshouses on areas of warm earth, enabling the commercial production of fruit and vegetables which previously had to be imported.

Thermal activity in Tuscany extends over an area of approximately a hundred square miles, in which fumaroles or powerful steam vents are characteristic features. In certain parts of this district the steam, after the small quantities of boric acid which it contains have been extracted, provides power for low-pressure turbines.

During the past ten years, wells have been sunk in "The Geyser" area of the St. Helena Range, near San Francisco, California. Despite the apparently feeble superficial activity compared with that of the thermal area of Tuscany it is of interest to note that half of the small number of wells developed in this area are superior both in pressure and steam output to any yet reported in Italy.

The foregoing remarks are offered merely as an introduction to a most interesting subject. It is now proposed to discuss a little more fully the natural heat resources of the various countries concerned. Reference will also be made to the possibilities of developing the natural heat resources in the thermal districts of this Dominion.

ICELAND.

This island, situated between 63·5° and 66·5° of latitude in the North Atlantic Ocean, covers an area of some 65,000 square miles, consisting mostly of lava plains, glaciers, and other barren features. Broadly speaking, about half the remainder, comprising sandy plains and shingle slopes, is in grass. The soil available for cultivation is fertile, but in consequence of the cold climate (mean temperature, 37° F.) vegetation does not flourish except in the vicinity of hot springs, fumaroles, geysers, and warm pools distributed evenly throughout the country in some sixty-five localities. Such areas of heated ground, often a few acres in extent, do not freeze even in winter, but maintain a temperature of from 50° to 158° F. in the topsoil, permitting and encouraging the growth of native flora.

The historians of early Iceland frequently refer to the use of hot springs for laundrying and for providing hot water for baths. In this connection the record of the historian Sourri Sturlason (A.D. 1300) may be cited. Hot and cold water were led from a warm pool close to his farm in Reykholt to his wash-basins, in order that the temperature might be adjusted.

Despite the early acquaintance with earth heat in Iceland it is only within the last ten years that serious efforts have been concentrated on the scientific development of such a valuable natural asset. Furthermore, it should be quite evident from the description which follows that although the exploitation of thermal heat is still in its infancy, results recently obtained appear to justify fully the expense and trouble involved. It has evidently been quite a customary procedure for the Icelander to cook his food either in hot earth or in hot springs. For example, bread was prepared by placing the dough in tin moulds and then covering it up with hot earth or lowering it into hot springs. The article prepared in this way had the reputation of being very wholesome. The modern tendency, however, is to bring the hot water from the springs by means of leads to specially adapted ovens in the houses. Steam from hot springs is also the basis of the central heating-systems in many schools and farmhouses throughout the country.

About the middle of the nineteenth century a series of experiments led to the successful recovery of salt from sea-water by pumping the latter into shallow pans and evaporating with the aid of hot springs beneath. This procedure has had to be discontinued owing to the difficulties of obtaining a suitable market.

It is perhaps in agriculture that the most useful application of earth heat has been found. A small proportion of the ground in the vicinity of patches of warm water carries grass, and, while little or no attention has been directed to the improvement of these meadow lands, notable progress has been made in the cultivation of various crops such as potatoes, cauliflowers, and cabbages, which are grown extensively in the warm soil areas. In several cases the warm areas have been extended by means of a system of hot-water earthenware pipe-lines under the ground. Such pipes are said to heat the surrounding soil for a distance of about 15 ft.

The results of these and other experiments have been responsible for the erection of glasshouses on specially selected areas of warm

FIG. 1. SHOWING METHOD OF HARNESSING A HOT SPRING IN ICELAND FOR USE OF A SMALL DAIRY-FACTORY.

FIG. 2. GLASSHOUSE AT REYKIR, ICELAND, UTILIZING NATURAL HEAT FOR THE GROWING OF MELONS.

[*From* "*Die Ernährung der Pflanze.*"

soil. Since the installation of the first glasshouse in 1923 several others of a more substantial type have been constructed, and not only has the culture of fruit and vegetables formerly imported from more temperate regions now been rendered possible, but a small export trade in garden products has been developed. It is interesting to note that the following fruits and vegetables have been grown successfully: Cauliflowers, red beet, spinach, mangels, peas, lettuce, onions, tomatoes, cucumbers, melons, pumpkins, grapes, strawberries, mushrooms, and beans. It is also understood that the germination of seeds can be greatly assisted by the means described. The vitamin-rich melons and tomatoes are especially valued by the Icelanders, and it is hoped that the adoption of electric light for the glasshouse crops during the long and dull winter months will still further assist in the growing of the products mentioned.

Firing materials are very expensive in Iceland, but these are no longer required in the thermal locations, as the hot spring water is used for heating and cleaning utensils, for pasteurization of milk, and for warming the sheds and cow-houses. It may also be mentioned that spinning-jennies were at one time operated from hot springs.

It has been brought to our notice that the employment of steam heating for improving the production of crops is not confined solely to Iceland. It appears that in Yorkshire the waste steam and hot water woollen mills are run into reservoirs, and thence from a series of pipe-lines into adjacent fields. By this means the fields are kept at an optimum temperature for the production of rhubarb, which is not only obtainable earlier, but is of better quality than that grown in other parts of the district.

TUSCANY.

The thermal area in Tuscany, occupying some hundred square miles of territory on the heavily wooded Catena Metallifera Range, is situated to the south of Pisa and is bordered by the higher valleys of the Cecina and Cornia Rivers. The volcanic manifestations take the shape of powerful steam jets or *soffioni* as they are known locally, which by their erosive action form about their orifices pools of muddy water or *lagoni*. The economic development of these is dependent upon the small amount of boric acid (approximately 1 part per 1,000 of the *lagoni* water) accompanying the steam.*

Towards the end of the eighteenth century attempts were made to recover the boric acid by evaporating the *lagoni* waters with the aid of ordinary fuel. In the year 1827 Larderello, an engineer, greatly improved the method by employing the steam from the *soffioni* to evaporate the boric acid; the product thus obtained, however, was only 82 per cent. pure as compared with the 99 per cent. article now produced. Since 1899, under the skilful guidance of Prince Ginori Conti the work of Larderello has been considerably advanced. The old *soffioni* are now replaced by artificial wells 180 to 600 ft. deep, from which steam is led through steel pipes and

* Dr. Wohlmann records in his book, "Mineral Waters and Spas of New Zealand," that the Hanmer Springs contain 25·1 grains of borax per gallon, and the White Island lake 21 grains of boron trioxide per gallon, or expressed as boric acid 0·060 and 0·32 parts per 1,000 respectively.

washed with uncontaminated water to extract the boric acid. The water for this operation is obtained either by pumping or from the natural steam. After the further extraction of carbon dioxide the steam passes on to low pressure turbines to supply electricity in bulk not only for the needs of local industry, but to Italian cities situated some considerable distance away. The concentration of the extracted boric acid is accomplished in a series of shallow lead evaporating receptacles approximately 150 ft. by 3 ft. in size. These gently sloping pans are so arranged that the boric acid solution flows from one pan to the next against the counter current of steam underneath, and thence into a vat where the liquid cools and the boric acid crystallizes out.

Among the by-products of the boric acid industry are ammonium carbonate formed from the separated and purified ammonia and carbon dioxide, borax obtained from the fusion of boric acid with sodium carbonate, and sodium perborate used for bleaching purposes.

In the light of these remarks it is noteworthy that although the power plant at Larderello is responsible for the refining of the products from the *soffioni* this establishment is only one of eight similar power plants which together constitute the Societa Boracifera di Larderello; further, it is considered by Prince Conti that the areas now worked, constituting but a small part of the whole thermal region, are far from being fully developed.

The *Journal of the Society of Chemistry and Industry* for 3rd July, 1931, gives the estimated output in kilograms (1 kg. = 2·2 lb.) of the principal products manufactured by the Societa Boracifera in 1930 as follows: Boric acid (crude), 590,000; boric acid (pure), 1,100,000; borax, 3,100,000; ammonium carbonate, 275,000; sodium perborate, 30,000; carbon dioxide, 195,000.

CALIFORNIA.

The area referred to here occurs as a part of a more extensive thermal region situated round about the rugged St. Helena or Mayacmas Range, commencing from thirty miles north of San Francisco and extending nearly fifty miles parallel to the coast.

Thermal activity is evident on both the eastern and western sides of the range, but on the western side it is the more pronounced. This is interesting in view of recent attempted industrial developments. On the western slopes of the range a hypothetical fault-line connecting the mercury deposits and springs has been traced for twenty-five miles along a creek known as Sulphur Creek, the bed of which is a narrow canyon forming the southern boundary of the St. Helena Range. The most active part of this line is "The Geysers," an old health resort provided with an accommodation-house dating back as far as the year 1852.

The thermal activity of the locality is evidently feeble, as the great majority of natural vents may be described as merely gas seepages, although the ground temperature in parts may be as high as 208° to 210° F. Only three active fumaroles occur, and these are situated on the banks above Geyser Creek. The hot springs are also shallow and quite insignificant as regards size, although the temperature of the issuing water is seldom below 140° F.

The credit of first attempting to exploit the natural steam of this district would appear to belong to J. D. Grant, of Healdsburg, California. Of the four wells sunk between the years 1921 and 1924 on the eastern bank of Geyser Creek by this promoter, the first failed because the steam pressure generated, on closing the well, blew out the casing, and the fourth, sunk on the extreme border of the hot ground, was discontinued at a depth of 154 ft. In the first successfully sunk well, after drilling through some 180 ft. of decomposed rock and piercing a sandstone cap, an 8 in. steel casing was lowered and finally fixed in the rock with molten zinc. Eventually, by continuing the boring as an open hole a depth of 203 ft. was reached, giving a static steam pressure of 62 lb. per square inch. The steam power from this well was used to bore a second well to a depth of 318 ft., providing a static steam pressure of 61 lb. per square inch.

In January, 1925, the work of this pioneer was taken over by the Diamond Drill Contracting Co. of Los Angeles. This company, by reason of its strong financial backing, was able to continue the work on a larger scale, and by June, 1926, five wells ranging in depth from 450 ft. to 650 ft. were put down. There were thus in all seven wells ranging from 200 ft. to 650 ft. in depth, and in static pressure from 60 lb. to 275 lb. per square inch. The principal facts to be learnt from the behaviour of these artificial steam-wells are (1) a steam flow may be developed by boring anywhere within the hot area, (2) the pressure of steam increases with the depth of the boring, (3) boring gives rise to steam-wells which even when close together may exhibit widely different pressures, (4) each well, after a period of discharge, when closed again returns to its original pressure.

It is not known to the writers to what extent the steam from these wells has been utilized, but from all accounts four of the wells established by the company together are estimated to represent a switch-board delivery of 4,500 kilowatts.

THERMAL RESOURCES IN NEW ZEALAND.

The thermal region of New Zealand is usually defined as ranging from the central volcanoes south of Taupo in a northerly and north-easterly direction comprising the Rotorua district, and extending over the Bay of Plenty as far as White Island and Whale Island. The fumaroles generally occur in groups, but in some cases are met with isolated. Among some of the fumaroles may be mentioned the large group at Ketetahi and Tokaanu to the south of Lake Taupo; others occur at Wairakei, Orakeikorako, Waiotapu, Rotorua, Waimangu, and elsewhere. None of these fumaroles, except the Karapiti blowhole near Wairakei, are very powerful, but notwithstanding this a good pressure of steam could no doubt be obtained by boring in suitable spots as in California.

The main hot springs groups are at Tikitere, Whakarewarewa, Ohinemutu, Waimangu, Waiotapu, Orakeikorako, Wairakei, Rotakawa, Taupo, and Tokaanu, although hot springs are to be found in widely scattered locations in both the North and South Islands. At Ohinemutu, Ohaki, and Tokaanu the springs are all alkaline; the remaining groups are acid, or partly acid and partly alkaline. There is little doubt also that the thermally altered ground round the alkaline group of springs is acid. It is in this particular direction that difficulties would be

encountered if any attempts were made to utilize natural heat resources, for the acidity of the water in some of the hot springs has a corroding effect on iron or steel pipes, necessitating the use of glazed earthenware pipes; moreover, the soil in immediate proximity to springs, being of an acidic nature, would require special treatment before being adapted for horticultural purposes. Nevertheless it would appear that difficulties encountered in the form of acid springs, &c., have been overcome in the countries already mentioned.

The Maori inhabitants of our thermal region have long known how to take advantage of the exceptional natural facilities, with the result that Native villages are to be seen close to conveniently situated hot springs, and it is still customary for the Natives to bathe and wash clothes in hot pools, and to cook food placed in flax baskets which are lowered into suitable steam vents.

According to Dr. Herbert, in "The Hot Springs of New Zealand" (1921), the Sanatorium gardens at Rotorua were set out by taking soil and placing it in a wilderness of sulphur beds and pumice. As the subsoil is warm these gardens constitute an ideal forcing ground for flowers, which bloom in profusion. It would seem that properly controlled warming of the ground by means of pipes from hot springs or the making of hotbeds in suitably chosen areas would remove the dangers of the hard frosts which are common at Rotorua in winter, thereby assisting in the early or out-of-season production of certain hothouse and other horticultural crops under the influence of the sunny climate. In many parts of the district the soil is of good texture and is remarkably responsive to phosphatic fertilizers in particular.

It may be mentioned in passing that at one time the gas from the Hanmer Springs (South Island), consisting chiefly of methane, was collected and utilized for lighting and cooking purposes at the sanatorium there.

It appears that the hot spring localities in Iceland have already been carefully surveyed and mapped, and a similar complete compilation and correlation of recorded data of the characteristics and locations of all the hot springs in New Zealand would be of considerable assistance in deciding the possibilities of exploitation of these natural resources from the industrial and agricultural standpoint. A close study of the mineral content of the local thermal springs might possibly indicate the position in regard to the profitable recovery of certain chemical substances by evaporation with the abundant natural heat. In particular the expensive iodine salts, which are held to be present in relatively large quantities in a number of hot springs—Morere and Te Puia Springs, for example—might possibly be utilized for pharmaceutical purposes and for iodized licks for farm animals. Some of the other salts present (notably common salt in abundance) might also in the future be recovered and appropriately used. Some of the gases accompanying fumarole steam have commercial importance—for instance, carbon dioxide, the chief gaseous constituent of the volcanic steam of many thermal regions has been successfully recovered in Tuscany.

In conclusion, it may be pointed out that the thermal region of New Zealand compares favourably with that of Iceland in several respects, including extent, power, adaptability, and suitability of soil and climate for agricultural utilization.

THE COOL STORAGE OF ONIONS.

R. SUTHERLAND, Cool Storage Officer, Department of Agriculture.

ALTHOUGH it is well known that onions can be kept for a lengthy period in common storage, it is also known that, as with most other perishable products, they tend to decompose if not protected by refrigeration. The conditions most favourable for this decomposition are heat and moisture; therefore the prompt removal of heat and the proper control of humidity ensure an efficient safeguard against deterioration.

The three elements which influence the life of onions in cool storage are temperature, humidity, and ventilation. Experiments have been carried out from time to time in order to determine how these elements should be combined to provide the most favourable storage conditions for the preservation of onions, and while it is well known that the varieties which keep best in common storage will remain in good condition for a longer period in cool storage, it is recognized that it may not be desirable in commercial practice to follow out certain methods with all varieties when grown under varying soil and climatic conditions.

Prestorage factors: Growers of onions who have been storing their product in common storage are fully aware of the fact that, like all other perishable commodities, apart from variety characteristics, maturity at the time of gathering, the nature of handling, cleaning, and drying are most important factors which have considerable influence on the storage life of this vegetable, both in common or cool storage. If onions are damaged during harvesting, packing, or handling, and not be thoroughly dry, they will very soon commence to decay.

Stowage: Only the good keeping varieties should be placed in cool storage, and the onions should be packed in bags or crates made of wood and stacked in the compartment in such a way as to allow the cold air to circulate round them. If stowed in bags, shelves should be provided in order to prevent bruising by the weight of the onions in the top bags pressing on the lower ones.

Onions must be stored in a separate compartment: While any of the several systems of refrigeration in general use may be suitable for the cooling of onions, providing adequate provision is made for circulation of the cold air and for ventilation, it should be borne in mind that a refrigerating system cooling a room in which this vegetable is stored must not be common to a compartment containing another commodity, otherwise the goods may become tainted by the gas given off by the onions and thereby spoiled.

A LOCAL INVESTIGATION.

During the present year a trial on a commercial scale was carried out with 80 tons of onions of the Straw Spanish variety. These were grown at Pukekohe, packed in ordinary onion bags, and forwarded by rail to cool storage at Wellington. The first consignment came to hand on 13th February and the last on 2nd March. As each lot came forward the onions were immediately placed in the cool compartment which had been specially prepared for them. The cold storage company undertook its part not only in this regard but also

in connection with the maintenance of uniform conditions during storage. It was evident that the growers had exercised every care in the harvesting, drying, and packing of their crop for storage, as with the exception of a number of double onions, which should have been rejected, all were in sound condition.

Fitting of the Compartment for Stowage.—The storage compartment was fitted with a system of shelves the length of the room. These were made of hardwood battens in the form of a grid, spaced in such a manner as not to interfere with the circulation of cold air through and between the containers. The distance between the shelves was just sufficient to take the bags filled with onions, standing on end, so that the onions in each individual bag would have only to support their own weight on the platform, and not be subject to that of a number of other bags. This eliminated the danger of faulty stowage and bruising of the product, to which a large amount of wastage is often due.

System of Cooling.—The storage compartment, which was cooled by the brine pipe or grid system, was fitted with trunks and a fan for circulating the cold air, and with special openings for ventilating the room by drawing in fresh air through one channel and discharging the gas given off by the onions through another channel into the external atmosphere.

Temperatures.—The storage-room and the insulation were cooled before loading commenced, and a temperature of 31° F. maintained as uniformly as possible during loading and throughout the storage period. The only variation occurred during ventilation, when the temperature rose to 32°–33° F. As the storage temperatures for onions vary slightly according to variety characteristic, and cultural and climatic factors, this variation in temperature was too small to require much consideration.

Ventilation and Humidity.—The accumulation of gas given off by the onions was prevented by ventilating the room daily by the process referred to above, care being taken not to allow the temperature or relative humidity to rise unduly during the period the ventilating shutters were open to the atmosphere. This minimized the danger of sprouting which is likely to occur, particularly in the early spring, should the temperatures or moisture content of the atmosphere in the compartment rise above normal for any length of time. During the first four weeks the relative humidity in the storage-room was 81 per cent., after which it was reduced to 78 per cent., and held as steady as possible during the storage period.

Results.—Inspections were carried out at frequent intervals, and the onions were in good condition after storage for between six and seven months. Although it is quite possible that the onions would have stored successfully for a further period, they were discharged and sold at a price which should leave the producer a good profit after allowing for all handling, transport, and cool storage charges. Specimens removed from storage at intervals remained sound and were comparable in every way to the newly gathered product.

By the production of the more hardy varieties of onions and the utilization of available cool storage facilities, the ability to supply our local markets throughout the greater part of the year may be anticipated.

WHEAT VARIETY TRIALS IN THE SOUTH ISLAND, SEASON 1931-32.

Fields Division, Department of Agriculture.

FOURTEEN trials to determine the relative yielding-capacities of certain wheat varieties or selected lines of crossbred wheats were laid down in Canterbury, Otago, and Southland during the 1931–32 season in collaboration with the Wheat Research Institute.

The *Journal* for June, 1931, contained a summary of three years' wheat variety trials conducted up to and including season 1930–31, and although in these trials Solid-straw Tuscan had definitely proved its superiority in most districts it was decided to carry out further trials with varieties in selected districts where the superiority of Solid-straw Tuscan had not been definitely established. In three trials lines of a cross between Solid-straw Tuscan and White Fife, supplied by the Wheat Research Institute, were tested against Solid-straw Tuscan and one or two other varieties. Some lines of this cross gave promise of having milling and baking qualities superior to those of Solid-straw Tuscan, and preliminary trials indicated that certain lines gave yields as good as that of the Tuscan under certain conditions. Samples of all varieties were forwarded to the Wheat Research Institute after harvesting for milling and baking tests.

For purposes of this report the trials here described are divided into three classes—namely, " Standard " variety trials, in which the most commonly used wheats were compared ; " Quality " variety trials, in which high-quality wheats such as Garnet or Marquis are included ; and " Crossbred " trials, in which lines of Cross 7 (Solid-straw Tuscan × White Fife), referred to above, are compared with Solid-straw Tuscan and one or two other varieties.

For layout of the trials, rate of seeding, manuring, and statistical examination of results, reference should be made to this *Journal* for June, 1931, pages 398 and 399.

Harvesting: Owing to extremely dry conditions prior to the 1932 harvest three of the fourteen trials could not be harvested, and in a few other cases the straw was only just of sufficient length for harvesting to be carried out. Wherever possible each variety was cut when ripe, but labour facilities did not always allow of this being done, and in some cases varieties had to stand for some days after ripening at the risk of being shaken. In one or two trials the grain was badly sprouted and discoloured as a result of wet and humid conditions when the wheat was in stook.

" STANDARD " VARIETY TRIALS.

Seven of these trials were sown, but only five were carried to completion. Details of the latter follow, and the yields are summarized in Table 1.

(1) *Trial No. 16/3/7 : F. G. Horrell, Horrelville, North Canterbury.*

Date sown, 5/5/31. Major cut 12/1/32, Dreadnought cut 14/1/32, Solid-straw Tuscan, Solid-straw Velvet, Yeoman, and Victor cut 23/1/32. The crop was affected with " take-all," causing a number of plants to

Table 1.—Yields of Varieties in "Standard" Class Trials, 1931–32.*

Variety.	(1) F. G. Horrell, Horrelville.		(2) High School, Rangiora.		(3) A. Grant, Waimate.		(4) G. Stevenson, Weston.		(5) J. Newlands, Ngapara.		Lincoln College.†
	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Velvet.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan ..	40·7	..	60·7	..	47·5	..	27·5	..	‡	..	..
Major§	51·7	**+11·0**	65·1	**+4·4**	54·5	**+7·0**	..	..	..	..	**−19·9**
Solid-straw Velvet§ ..	35·4	**−5·3**	59·0	−1·7	..	..	..	..	..	..	+1·7
Yeoman	36·6	**−4·1**	50·6	**−10·1**	51·9	**+4·4**	43·5	**+16·0**	..	..	**−17·0**
Victor	42·8	+2·1	61·2	+0·5	..	..	..	..	..	..	**−13·6**
Dreadnought ..	56·4	**+15·7**	..	..	56·2	**+8·7**	41·8	**+14·3**	..	..	**+4·4**
College Hunter's II ..	..	..	57·1	**−3·6**	51·7	**+4·2**	..	..	..	..	**−17·5**
Velvet 18/27 ..	..	..	..	..	57·7	**+10·2**	..	..	14·4	−0·7	..
Velvet	..	..	..	..	..	..	..	..	15·1	..	**−11·6**
Dreadnought 5/27 ..	..	..	..	..	..	..	42·0	**+14·5**	..	..	**+5·5**

* See Table 2 for a trial including Victor. † Figures taken from report of Wheat Research Institute for quarter ending 31/5/32. As these are the results of two trials, differences only from Solid-straw Tuscan are given. The average yields of Tuscan in these trials was 62·2 and 67·1 bushels per acre respectively. Major was badly damaged by birds. ‡ Solid-straw Tuscan was not used in this experiment. § See Table 3 for two other trials including these varieties.

NOTE.—In this and the following tables differences preceded by a plus sign denote an increase over Solid-straw Tuscan; a minus sign denotes a decrease. Increases or decreases printed in heavy type are statistically significant.

lodge. The binder, however, was able to pick up most of the heads. A little shaking occurred with Yeoman and Victor during cutting. Many heads of Solid-straw Velvet were lost when carting the sheaves for threshing.

(2) *Trial No. 16/3/429 : High School, Rangiora, North Canterbury.*

Date sown, 22/6/31. Major cut 12/1/32, Solid-straw Tuscan, Victor, College Hunter's II, Yeoman, and Solid-straw Velvet cut 22/1/32. When cut Hunter's had the tallest growth, overtopping the other varieties by 4 in. to 5 in. Yeoman and Victor were an inch or two below the growth of Tuscan, which was about equal to Major and Solid-straw Velvet. Solid-straw Tuscan and Solid-straw Velvet were the ripest when cut, Hunter's not quite so ripe, while Yeoman and Victor were the least ripe of the varieties.

(3) *Trial No. 16/3/494: A. Grant, Waimate, South Canterbury.*

Date sown, 18/6/31. Major cut 29/1/32, Solid-straw Tuscan, College Hunter's II, Dreadnought, Velvet 18/27, and Yeoman cut 2/2/32. The crop was fed off, and on 7/10/31 considerable differences in the varieties as a result of the feeding-off were apparent. Tuscan had been eaten bare, while Major had also been well sought after; Velvet had been more or less neglected by stock. On 29/1/32 Tuscan, which looked the poorest, had developed stem-rust badly; the other varieties were also attacked, but to a lesser extent. On 2/2/32 it was observed that Hessian fly had attacked Dreadnought badly, and the other varieties, except Tuscan, had also been slightly attacked. At threshing all varieties were badly sprouted except Tuscan, which yielded quite a good sample of grain. Hunter's was in the worst condition and was not really fit to thresh.

(4) *Trial No. 16/4/286: G. Stevenson, Weston, North Otago.*

Date sown, 27/5/31. All varieties—Solid-straw Tuscan, Dreadnought, Dreadnought 5/27, and Yeoman—cut 13/2/32. At cutting all varieties were at about the same stage of maturity. The crop was fed off during September. Tuscan was grazed hard; other varieties were fairly well grazed except Dreadnought 5/27, which was hardly touched by stock.

(5) *Trial No. 16/4/222B : J. Newlands, Ngapara, North Otago.*

Date sown, 3/6/31. Local Velvet and Velvet 18/27 both cut 26/2/32. There was not a great deal of difference in the appearance of the two strains; both were fairly light and had shaken rather badly.

"Quality Variety" Trials.

Four trials, in which one or more of the high-quality wheats were included, were laid down, but only three were harvested. Details of these follow, and the yields are summarized in Table 2.

(6) *Trial No. 16/3/505: S. Lemon, Lyndhurst, South Canterbury.*

Date sown, 23/9/31. Garnet cut 25/1/32, Reward cut 27/1/32, Marquis cut 6/2/32, Solid-straw Tuscan and White Fife cut 10/2/32. On 25/1/32 Garnet was slightly riper than Reward; a certain amount of shedding of grain took place; Marquis was still quite green. On 27/1/32 Reward was cut with the binder, when a heavy loss of grain

occurred owing to shaking under the action of the packers and the shortness of the crop. On 26/2/32 Marquis lost grain from a north-wester just before cutting, and a fair proportion over the binder. On 10/2/32 White Fife was not as ripe as the remainder. This variety was especially attacked by wire-worm. Being the tallest-growing of the varieties, it made the best sheaves with the least loss of grain. There was a fair loss with the Tuscan owing to its short growth.

(7) *Trial No. 16/4/303: C. Milne, Milton, South Otago.*

Date sown, 17/9/31. Marquis and Major cut 29/2/32, Solid-straw Tuscan and Solid-straw Velvet cut 11/3/32. On 29/2/32 Marquis was dead ripe, and the nodes of Major were still greenish in colour. Losses of grain occurred when cutting Major and Marquis. On 11/3/32 the Tuscan was dead ripe, whereas the Velvet was still green at the nodes. On 6/4/32, at threshing, samples of grain were on the damp side, and of the four varieties Tuscan seemed to be the driest. Solid-straw Velvet was the only variety to develop stem-rust.

(8) *Trial No. 16/4/314: Experimental Area, Gore, Southland.*

Date sown, 6/10/31. Garnet cut 7/3/32, Marquis cut 15/3/32, Major, Solid-straw Velvet, and Solid-straw Tuscan cut 1/4/32. Garnet, Marquis, and Major were all ripe when cut. The Velvet and Tuscan would have required another fortnight before being properly fit, but, owing to foggy weather causing discoloration of grain and bad infection of stem-rust, these varieties were cut at the same time as Major. All varieties were badly damaged by birds just prior to harvesting and while in stook. Garnet suffered more from bird damage than did the other varieties, on account of earlier ripening and the fact that it was longer in stook.

Table 2.—Yields of Varieties in "Quality Variety" Class Trials, 1931–32.

Variety.	(6) S. Lemon, Lyndhurst.		(7) C. Milne, Milton.		(8) Experimental Area, Gore.	
	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan	31·9	..	59·4	*	53·2	*
Marquis† ..	16·4	‡	58·2	−1·2	47·4	−5·8
Garnet ..	23·9	**−8·0**	..	..	24·9	−28·3
Reward ..	15·3	‡	..	..	..	..
White Fife ..	22·7	**−9·2**	..	..	..	..
Major	..	..	51·9	−7·5	47·2	−6·0
Solid-straw Velvet	..	..	58·7	−0·7	42·9	−10·3

* Yields not treated statistically. † See Table 3 for a further trial including Marquis.
‡ Not comparable with Solid-straw Tuscan. Garnet was significantly better than Marquis to the extent of 7·5 bushels per acre. Reward was significantly lower in yield than Marquis by 1·1 bushels per acre.

"CROSSBRED" TRIALS.

Three of these trials were laid down and harvested. Details are given below, while the yields are summarized in Table 3. Various lines of the cross—White Fife × Solid-straw Tuscan—are indicated by numbers—for example, 7·05.

(9) *Trial No. 16/3/498: D. Mulholland, Darfield, Canterbury.*

Date sown, 5/6/31. All varieties cut 20/1/32. Varieties, Solid-straw Tuscan and Victor. Crosses, 7·01, 7·02, 7·04. On 20/1/32 Victor had the least growth of the varieties; Solid-straw Tuscan had the most growth, being about 1 in. taller than the crosses. Tuscan ripened with a perpendicular head, whereas the crosses had a drooping head and had developed more out of the shot blade than had the Tuscan. This trial suffered from the extremely dry pre-harvest conditions.

(10) *Trial No. 16/3/426: J. Ruddenklau, Methven, Canterbury.*

Date sown, 1/6/31. All plots cut 1/2/32. Varieties, Solid-straw Tuscan and Marquis. Cross, 7·05. On 1/2/32 Marquis was dead ripe, Tuscan was just right for cutting, but Cross 7·05 was a shade greener. Marquis had shed some grain and the sheaves were very light. Both Tuscan and Cross 7·05 had much stem-rust; Marquis had very little in comparison.

(11) *Trial No. 16/3/428: A. Amos, Wakanui, Canterbury.*

Date sown, 5/6/31. All plots cut 20/1/32. Variety, Solid-straw Tuscan. Crosses, 7·06, 7·08, 7·09. On 20/1/32 all varieties were ripe and none had shaken. A little stem-rust was showing throughout. The straw was fairly short.

Table 3.—Yields of Varieties in "Crossbred" Trials, 1931–32.

Variety.	(9) D. Mulholland, Darfield.		(10) J. Ruddenklau, Methven.		(11) A. Amos, Wakanui.		Lincoln College.*	
	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.	Yield, in Bushels per Acre.	Difference from Solid-straw Tuscan.
Solid-straw Tuscan ..	23·7	..	45·2	..	49·7	..	†	..
Cross 7·01 ..	18·8	**−4·9**	..	..	..	..	56·1	**−15·2**
Cross 7·02 ..	24·4	+0·7	..	..	..	..	70·1	+2·0
Cross 7·03 ..	..	..	..	..	..	..	70·7	+1·1
Cross 7·04 ..	24·5	+0·8	..	..	..	..	70·0	−3·5
Cross 7·05 ..	..	..	43·9	−1·3	..	..	67·3	**−7·0**
Cross 7·06 ..	..	..	..	..	44·7	**−5·0**	70·4	−3·9
Cross 7·07 ..	..	..	..	..	..	..	66·3	**−7·6**
Cross 7·08 ..	..	..	..	..	43·1	**−6·6**	60·4	**−18·2**
Cross 7·09 ..	..	..	..	..	46·9	**−2·8**	68·5	**−5·1**
Marquis	..	..	34·6	**−10·6**	..	..	..	..
Victor	17·9	**−5·8**	..	..	..	..	..	..

* Results taken from report of Wheat Research Institute. † The average yield of all Solid-straw Tuscan plots was 72·5 bushels per acre.

TRIALS LAID DOWN BUT NOT HARVESTED.

Trial No. 16/3/503: E. A. Woodfield, Horrelville, North Canterbury.

Solid-straw Tuscan, Garnet, Reward, Marquis, and White Fife were sown in this experiment on 7/9/31. Owing to the extremely poor growth after dry conditions, and the shortness of the crop, the plots were not harvested separately. The Tuscan, although very poor, was the best variety and was the only one which formed grain to any extent. Garnet was possibly the next best, and had more growth than the remaining varieties.

Trial No. 16/3/490: J. Armstrong, Claremont, Canterbury.

The varieties in this trial—Solid-straw Tuscan, Major, Dreadnought, Yeoman, Victor, and College Hunter's II—were sown on 27/5/31. On 28/1/32 Major was cut; Hunter's had shaken slightly during a heavy gale, but was not yet fit for harvesting. On 3/2/32 Dreadnought was cut, as it had commenced to shake, although the grain was soft. On 5/2/32 the remaining varieties were harvested; Yeoman was slightly on the green side. As a result of heavy rains and humid conditions when in stook the crop germinated badly, and was not fit for threshing. The experiment was therefore abandoned.

Trial No. 16/4/222A: J. Newlands, Ngapara, North Otago.

This trial, which was sown on 2/6/31, included Solid-straw Tuscan, Major, Hunter's, Dreadnought, and Velvet 18/27. On account of the poor growth as a result of dry conditions, it was decided not to attempt yield determinations, and the trial was abandoned.

Trial by Wheat Research Institute.

In addition to the foregoing a trial conducted by the Wheat Research Institute at Lincoln, in which many of the "quality" wheats were included, was affected by the drought. The varieties in this experiment were Solid-straw Tuscan, Marquis, Reward, Garnet, and White Fife, while the Kansas varieties Oro, Tenmarg, and Kanred × Marquis, were also included. Two sowings of these, on 15/5/31 and 10/9/31 respectively, were made. It is reported that all through the growing season it was apparent that the Tuscan and Garnet sown in autumn would be the only varieties to give any crop at all. The other varieties, owing to the effect of drought being particularly severe on the class of land on which the experiment was sown, ultimately produced ears of about ½ in. in length without any grains at all.

General Remarks.

The results of three trials carried out by the Wheat Research Institute at Lincoln College are included in the tables at the request of the Director of the Institute.

In view of the influence of season and soil on the performance of varieties it is considered advisable to withhold comments on this year's results, but to consider the merits of varieties over the whole of the seasons during which they have been tried as soon as the present season's work is completed. Most of the varieties, with the exception of the "quality" wheats, are again under trial in parts of Canterbury and North Otago. Some of the "quality" wheats will be tried again in South Otago.

The thanks of the Department are extended to those farmers who provided facilities for carrying out these trials. The field work in Canterbury and Otago was under the supervision of Mr. R. McGillivray, Fields Superintendent, Christchurch, and Mr. R. B. Tennent, Fields Superintendent, Dunedin, respectively. The trials were conducted in their respective districts by Messrs. G. G. Calder, W. Stafford, T. Sellwood, E. M. Bates, A. A. Hume, and A. Stuart, Instructors in Agriculture, and at Gore Experimental Area by Mr. W. Sleeman, Overseer.

—A. W. Hudson, Crop Experimentalist, Plant Research Station, Palmerston North, and J. W. Woodcock, Assistant Crop Experimentalist.

SEED CERTIFICATION.

SUMMARY OF OPERATIONS FOR SEASON 1931–32.

Reported by J. H. CLARIDGE, Assistant in Agronomy, Department of Agriculture.

OPERATIONS in connection with seed certification were again undertaken by officers of the Fields Division during the 1931–32 season. The scheme was extended to include the certification of cocksfoot, Montgomery Late Red clover, and Kentish Wild White clover. Changes in the scheme included the introduction of a system of charges (particulars of which were published in the *Journal* for September, 1931) and the alteration of the certification of white clover from an age basis to one of type.

Perennial Rye-grass.

There was again a considerable increase in the perennial rye-grass seed certified. The quantity of seed sealed during each of the last three seasons' operations is as follows: 1929–30, 17,052 bushels; 1930–31, 45,983 bushels; 1931–32, 81,186 bushels. Nevertheless, the price of certified rye-grass seed is still high, and the demand is greater than the supply. There is, however, a rapidly increasing supply of seed becoming available in the South Island. Already a keen demand for certified seed is being exhibited by Australian merchants; while inquiries have also been received from other countries. It is certain that the amount of certified rye-grass seed produced can be considerably increased without danger of overproduction.

It is encouraging to note that seed twice grown in Canterbury from certified mother seed is still maintaining its true perennial characteristics. In this connection it was decided at the commencement

Table 1.—Perennial Rye-grass Field Inspection Results, Season 1931–32.

(Figures in parentheses refer to the 1930–31 season; this applies to all tables in which such figures occur.)

Field Superintendent's District.	Mother Areas.		Permanent Pasture Areas.						Total Areas passed.		Areas rejected.	
			Mother.*		Permanent Pasture only.		First Harvest.					
	Number.	Acres.	Number.	Acres.	Number.	Acres.	Number.	Acres.	Number.	Acres.	Number.	Acres.
Auckland ..	1	10	..	..	..	..	2	6	3	16	..	..
Palmerston N.	214	2,322	365	4,005	79	867	84	689	742	7,883	27	251
	(90)	(1,066)	(276)	(3,302)	(27)	(237)	(35)	(356)	(428)	(4,961)	(84)	(758)
Christchurch ..	..	..	1	15	15	220	47	625	63	860	5	50
							(26)	(344)	(26)	(344)	(3)	(13)
Dunedin ..	..	..	..	..	10	119	50	505	60	624	3	25
					(1)	(34)	(19)	(416)	(20)	(450)	(1)	(13)
Total	215	2,332	366	4,020	104	1,206	183	1,825	868	9,383	35	326
	(90)	(1,066)	(276)	(3,302)	(28)	(271)	(80)	(1,116)	(474)	(5,755)	(88)	(784)

* The produce of these "Permanent Pasture" areas is subject to reclassification as "Mother Seed," provided the sample trial report indicates a sufficiently high standard.

Table 2.—Perennial Rye-grass Acreage Harvested and Sacks sealed in the Field, Season 1931–32.

Field Superintendent's District.	Mother Areas.		Permanent Pasture Areas: Mother.*		Permanent Pasture Areas: Permanent Pasture only.		Permanent Pasture Areas: First Harvest.		Total.	
	Acres.	Sacks.	Acres.	Sacks.	Acres.	Sacks.	Acres.	Sacks.	Acres.	Sacks.
Auckland ..	10	16	..	..	..	..	6	37	16	53
Palmerston North	2,129 (916)	4,333 (2,326)	3,467 (3,075)	7,255 (7,074)	784 (219)	1,725 (726)	657 (337)	3,406 (1,927)	7,037 (4,547)	16,719 (12,053)
Christchurch ..	..	..	15	41	203	549	556 (313)	1,974 (1,635)	774 (313)	2,564 (1,635)
Dunedin ..	..	..	..	..	83 (34)	179 (128)	473 (396)	2,590 (1,771)	556 (430)	2,769 (1,890)
Total ..	2,139 (916)	4,349 (2,326)	3,482 (3,075)	7,296 (7,074)	1,070 (253)	2,453 (854)	1,692 (1,046)	8,007 (5,333)	8,383 (5,290)	22,105 (15,587)

* See footnote to Table 1.

Table 3.—Perennial Rye-grass Machine-dressing Returns, Season 1931–32.

Class of Seed.	Into Machines. Sacks.	Into Machines. Bushels.	Out of Machines. Bushels.	Loss per Cent. during Dressing.	Yield in Bushels per Acre of Machine-dressed Seed.
Mother Seed—					
Auckland	11	44	41	7·0	6·0
Palmerston North ..	4,080	26,062	17,043	34·7	8·5
Total	4,091 (1,799)	26,106 (11,170)	17,084 (6,304)	34·6 (43·6)	8·5 (9·0)
Permanent Pasture (Mother) Seed—*					
Palmerston North ..	6,211	39,884	25,696	35·6	8·7
Christchurch	41	187	137	26·7	9·1
Total	6,252 (4,691)	40,071 (29,743)	25,833 (18,360)	35·4 (38·3)	8·7 (9·6)
Permanent Pasture Seed—					
Palmerston North ..	1,623	10,220	5,258	48·6	7·1
Christchurch	517	3,021	2,573	14·6	13·4
Dunedin	169	799	470	41·2	6·3
Total	2,309 (797)	14,040 (4,884)	8,301 (3,124)	40·9 (36·3)	8·2 (13·2)
Permanent Pasture (First Harvest) Seed—					
Auckland	37	109	47	56·9	7·8
Palmerston North ..	3,069	18,440	13,205	38·5	22·3
Christchurch	1,765	9,976	7,888	20·9	15·8
Dunedin	2,055	11,286	8,828	21·7	23·5
Total	6,926 (5,206)	39,711 (28,019)	29,968 (18,194)	24·4 (35·2)	20·6 (17·8)
Grand total ..	19,578 (12,493)	119,928 (73,815)	81,186 (45,982)	32·3 (37·7)	10·9 (11·9)

* See footnote to Table 1.

of the season to delete first harvest seed as a separate class, and to include it under the head of Permanent Pasture. The words "First Harvest Seed," however, are stamped across the tags and insert slips to differentiate it from other permanent pasture seed.

Tables 1, 2, and 3 give a summary of the results of the 1931–32 season's activities, making comparisons with the work of the previous season. In connection with the seed certified as "Permanent Pasture, eligible for reclassification as mother seed after sample trial," 90 per cent. of this seed has already been reclassified as "Mother," while about 9 per cent. has failed to come up to the necessary standard. A few lines are still under trial.

Cocksfoot.

Previous to the 1931–32 season numerous samples of cocksfoot seed grown on Banks Peninsula were tested out at the Plant Research Station. All of these samples proved to be typical of the New Zealand strain, so that when the certification of cocksfoot seed was introduced it was possible to treat the whole of the Peninsula district as suitable for the production of mother seed. As a result, practically all the seed from the Peninsula in the season under review was sealed up and certified as New Zealand "Mother Seed" cocksfoot.

The work of paddock sealing and branding on the Peninsula is carried out by inspectors of the Akaroa Cocksfoot-growers' Association, the latter acting under the guidance and supervision of the Department of Agriculture. In addition to this district, samples from a few areas in Mid-Canterbury and Otago had been submitted for trial, and were found to be of the desired type. Two of these areas were entered for certification, and, both being old pastures, were certified as mother seed areas.

The following table gives the number of areas and the acreage entered, the amount of seed harvested, and the quantity of seed finally tagged and certified as mother seed.

Table 4.—Cocksfoot Certification, Season 1931–32.

Item.	Akaroa.	Mid-Canterbury.	Otago.	Total.
Areas entered	129	1	1	131
Acreage entered	4,167	52	7	4,226
Sacks harvested	4,993	82	9	5,084
Sacks into dressing-machines ..	2,605	82	..	2,687
Bushels into dressing-machines	10,339	259	..	10,598
Bushels of machine-dressed seed	8,428	158	..	8,586
Percentage of loss in dressing..	18·5	39·0	..	19·0

White Clover.

As a result of the change in the scheme of certification of white clover, coupled with the general poor yield of white clover seed in the Dominion in the 1931–32 season, very little seed was certified.

Eight lines of certified white clover seed were obtained from the dressings of certified rye-grass in Hawke's Bay. After machine-dressing this gave 692 lb. of mother seed and 1,219 lb. of permanent pasture

seed. In addition, two areas in North Canterbury were entered specifically for white clover production, and from these 631 lb. of mother seed and 3,589 lb. of permanent pasture seed were sealed up and tagged. This gives a production of 1,323 lb. of mother seed and 4,808 lb. of permanent pasture seed, a total of 6,131 lb. certified for the season. It is expected that with more areas eligible for certification, the 1932–33 season will show a marked increase in the quantity of seed certified.

One area of Kentish Wild White clover sown with imported seed was entered for certification last season, but owing to the dry conditions it was later withdrawn.

Brown-top.

There was a remarkable increase in the amount of brown-top certified in Otago in the 1931–32 season, though in other districts a reduction took place. In South Canterbury, where in 1930–31 over 29,000 lb. of seed was sealed and tagged, in 1931–32, due to the exceptionally dry conditions, not one area was entered for certification.

Of the new areas entered which were subject to field inspection all were reported on as being free from red-top and eligible to

Table 5.—Brown-top Certification, Season 1931–32.

District.	Passed		Harvested	
	Number of Areas.	Acreage.	Number of Areas.	Acreage.
Mid-Canterbury ..	7 (11)	1,700 (2,090)	5 (11)	1,350 (2,090)
Central Otago ..	1	300	1	300
Otago	85 (70)	11,968 (9,533)	82 (44)	11,703 (6,280)
Southland	37 (77)	4,329 (7,769)	31 (55)	3,059 (5,734)
Total.. ..	130 (183)	18,297 (24,901)	119 (132)	16,412 (19,513)

Table 6.—Brown-top Harvested and Machine-dressed, Season 1931–32.

District.	Number of Sacks Harvested.	Into Machine-dresser.		Pounds of Machine-dressed Seed.	Percentage of Loss in Dressing.
		Sacks.	Lb.		
Mid-Canterbury ..	544 (1,062)	544 (1,048)	37,196 (79,655)	19,034 (45,103)	48·8 (43·3)
Central Otago ..	31	31	3,046	2,286	25·2
Otago	2,284 (828)	2,126 (812)	216,479 (64,926)	139,556 (49,109)	35·5 (24·3)
Southland ..	888 (736)	752 (714)	67,669 (66,280)	37,467 (47,411)	44·7 (26·8)
Total ..	3,747 (3,207)	3,453 (3,127)	324,390 (253,106)	198,343 (171,083)	39·0 (32·4)

produce certified seed. Tables 5 and 6 give the results of the season's operations. There is likely to be a little more seed machine-dressed, but the quantity will not materially affect the figures.

Red Clover.

Three areas of Montgomery Late Red clover (sown with imported seed) were entered for certification. One area was withdrawn, but the other two passed inspection, and the produce, amounting to 2,057 lb. of machine-dressed seed, was certified to as "New-Zealand-grown Montgomery Late Red clover."

(To be concluded next month with Seed Wheat, Potatoes, and Beans.)

WAIMATE WEST DEMONSTRATION FARM.

SOME NOTES ON THE 1931–32 SEASON.

J. M. SMITH, Instructor in Agriculture, Fields Division, New Plymouth.

THE season of 1931–32 from a weather point of view was one of the most trying that had been experienced in South Taranaki for some considerable time. A cold backward spring was followed by a very dry summer and autumn, and this condition lasted until it was too late for the rain to do very much good, on account of the cold nights.

The season, however, proved how sound was the policy of having a standby provision of hay and silage. Feeding of silage was started at the Demonstration Farm in March, two to three months earlier than usual, and the fodder conserved as hay and ensilage was such that it afforded six months feeding. This depleted the fodder reserves, but, given normal conditions, the current season should see the reserves largely built up again.

The intensive rotational grazing and nitrogen top-dressing trial, where eight 3-acre paddocks are under trial, was again carried on. Observations over the past three seasons indicate that with a herd of sixty cows these paddocks are too small. The value of nitrogen in relation to early feed was again demonstrated, although the cold backward spring retarded all pasture growth, even where nitrogen had been used. From an economic aspect, however, the value of nitrogen as an early feed producer has yet to be determined.

The lucerne stand proved a great standby during the summer and autumn. Usually the second cut is conserved either as silage or hay, but this cut was required for feeding out green in the season under review. The third cut was utilized in a like manner. A gradual invasion of grass has been taking place over the older portion of the lucerne paddock, and this part has been broken up, cropped, and resown. In resowing three varieties were used—Marlborough, Hunter River, and South African—and it is interesting to note that up to the time of writing the African appears to be doing the best. This area was sown down in November, 1931. Another portion of the older part of the paddock is being ploughed this current spring, and will be resown with lucerne straight away without prior cropping.

In an endeavour to find another fodder plant to assist the lucerne in times of drought an area is to be sown down this spring with paspalum. This has provoked a great deal of adverse criticism in the district, but this valuable summer and autumn grass is deserving of a thorough trial.

The usual pasture top-dressing trials with various phosphatic, potassic, and nitrogenous manures were carried on during the year. These trials continue to prove interesting and are of considerable value to the district.

The dairy herd during the past season numbered sixty, and this, together with eleven heifers, thirteen calves, two bulls, and three horses, made the stocking of the 92 acres of the farm particularly heavy. Up to the end of March the butterfat produced constituted a record, but the dry weather then told, and the season's production finished up 288 lb. behind that of the best previous year, though 346 lb. ahead of that for 1930–31. The butterfat production per acre amounted to 174 lb.

The concrete silo is not proving very satisfactory. It has now been filled twice, and each time waste has occurred to a depth of several inches round the walls. Similar experience is common in the district. It would appear that the trouble lies in the thin walls, which do not prevent the great variation of conditions that occurs within and without the silo at times affecting the silage. Other concrete silos, with walls 6 in. thick, do not occasion the same trouble.

FARM DAIRY INSTRUCTION.

DESPITE the generally low prices received for dairy-produce, and the tendency to reduce expenditure in consequence (states the annual report of the Dairy Division for 1931–32), it is pleasing to record that during the year none of the dairy companies associated with the Department in the employment of the Farm Dairy Instructors gave notice to discontinue this service. This, in itself, is a striking testimony to the value of the work carried out by these officers. In all, thirty-one Farm Dairy Instructors have been employed by seventy-seven dairy companies with 26,596 suppliers, and these companies have forwarded 59,071 tons of butter and 31,282 tons of cheese for grading. As there are approximately 64,000 suppliers to dairy companies, it will be seen that half this number receive little or no instruction in the care and handling of the raw material, which is so essential to the maintenance of the desired quality. As the present adverse economic conditions preclude the institution of farm dairy instruction on a national basis, factory-managers whose suppliers are not included in the voluntary farm dairy instruction service need to do what is possible to improve the milk-supply through careful examination of the milk at the receiving-stage, and by affording where possible the necessary assistance to their suppliers of faulty milk.

Importation of Live-stock into New Zealand.—The prohibition imposed on cattle, sheep, and swine from Britain as a precaution against the entry of foot-and-mouth disease is still in force, and the only countries from which stock may be imported subject to the regulations are: Cattle from Tasmania, Canada, and the United States (with the exception of California); swine from Australia (with the exception of Queensland and Western Australia) and Canada; and sheep from Australia (with the exception of Queensland and Western Australia). Importations of cattle from the United States and Tasmania are subject to the precedent consent of the Minister of Agriculture in each case.

SEASONAL NOTES.

THE FARM.

Outstanding Importance of Proper Utilization of Pastures.

ALMOST invariably at this time of the year the feed available on pastures is in excess of the requirements of stock, and the task of major importance facing farmers is the effective utilization of the surplus growth. This being a bountiful season, the need for proper control of pasture growth is intensified. Consequently the scope is greater than usual for the employment of such measures as ensilage and "topping," which were described in these notes in last month's *Journal*.

While it would be unfortunate to minimize the importance of ensilage and topping as means of maintaining pastures in a vigorous leafy condition, it is very desirable not to overlook the fact that the grazier's principal tool is the grazing animal, and consequently that skilful manipulation of stock in grazing is of prime importance. On many farms this consists mainly in the adoption of a judicious system of rotational grazing. Essential features of such a system are (1) intensive in contradistinction to extensive grazing; (2) periodical, even, and fairly close grazing of fields; (3) spelling of fields for periods of substantially longer duration than the periods during which the fields are grazed.

Intensive grazing is effected by concentrating stock on the fields being grazed. For example, in dairying under a system of rotational grazing the whole herd is confined to one or two fields, and the remainder of the farm under pasture is thus spelled. As a rule, stocking at the rate of six or more cows to the acre constitutes intensive grazing. Ordinarily in dairying a field should be stocked heavily enough to bring about periodical grazings of not more than two to three days' duration. To fields which are grazed for periods of longer duration there often attaches, towards the end of the periods, a staleness which detrimentally affects the animals.

While a field needs to be eaten down evenly and fairly closely before stock are transferred from it, it is important to remember in practice that both punishment of stock and punishment of swards need to be avoided. In his zeal to effect even, close grazing a farmer may readily overreach himself, and in this connection the degree of closeness which is usually advisable has at times been exaggerated. If the stock consist principally of cows in milk it will be necessary to transfer them from a paddock early enough to avoid any undesirable falling-off in production that would be brought about by keeping them longer on the paddock. At times, especially if droppings have not regularly been distributed, this involves transferring stock from a field before patches of ranker growth are eaten down. It is highly desirable to remove without delay the tall growth from such patches. This may be done either by the employment of dry stock to continue the grazing of the field immediately the milking stock have been removed, or by topping of the rank uneaten patches with the mower. Dry stock, to be effective for this purpose, must be available in numbers sufficient to lead to the eating down of the rank patches within a few days, and as often the stock are not available in such numbers then topping needs to be adopted.

Regular and thorough distribution of droppings by means of harrowing makes it much easier to maintain an even leafy growth over grassland during spring and early summer. It is advisable to endeavour to avoid harrowing grass just before a dry spell, for rain is needed to remove the soiling of the feed which harrowing at times brings about.

It is timely to consider that under certain circumstances close grazing of pastures, apart from the undesirable punishment of milking stock which

it is apt to involve, may lead to lowering of the yield of herbage. Such lowering of the rate of growth may occur not only during the critical dry period which frequently is experienced in the latter half of summer, but also later on and for considerable periods, especially if close grazing is practised repeatedly. A special endeavour should be made to avoid close grazing a short time before the customary dry summer spell, during which it is desirable to have the surface of the land covered as completely as possible with vegetation.

Stock should be returned to a field which has been spelled not necessarily when all other paddocks available for grazing have been eaten down in turn, but when the growth on the spelled paddock is at the stage best suited for grazing. For instance, on a farm on which ten paddocks are being grazed, one paddock may be ready for grazing again when only seven of the other nine paddocks have been grazed. In such a case the two ungrazed paddocks should be dropped from the grazing programme for a while, and a return made by the stock to the paddock which has so recovered from previous grazing as to be at the best stage for grazing again. It is of vital importance to drop promptly from the grazing programme any fields which in early summer are providing feed in excess of the current requirements of the stock. Good control of pasture growth at this period is of such value as to justify closing a field from grazing even though the manner in which the surplus growth on it will be used eventually is not determined. The dropping of sufficient fields from the grazing programme will ensure that the growth on the remainder is properly controlled, and it is better to achieve this, even if some feed on the closed-up fields is not used to the best advantage, than to face the alternative result—uncontrolled growth on all the fields under grazing.

Effective rotational grazing can be carried out without abnormally close subdivision of farms. This is indicated by the fact that highly satisfactory rotational grazing is being practised on farms consisting of from nine to twelve fields. During the season of rapid growth of pastures it is frequently advisable to return the grazing animals to a field after it has been spelled for a period of six to ten days, and if grazing is confined to four to six fields, each of which is stocked periodically for one to three days, then suitable periods of spelling are obtained for each field.

Possibilities of Summer Top-dressing.

At times, for the purpose of stimulating fresh leafy growth in the latter part of the summer, it may be an advantage to top-dress some of the pastures of a farm with superphosphate in early summer. It is to be expected that such top-dressing would prove most effective in districts in which a good deal of rain falls in December and January, and that as the December-January rainfall decreases it would decline in effectiveness as a means of obtaining additional late summer, leafy, fresh growth, until a point would be reached when it probably would not be worth doing. Areas from which hay or silage have been saved generally respond profitably to a December application of super, which is likely to lead to an increased production of leafy feed at a season when such feed is frequently in scant supply.

Ensilage.

Those desirous of obtaining full information about the best methods to employ in ensilage should consult Bulletin 146, obtainable free on application to the Department of Agriculture.

A common fault in ensilage is the development of too high a temperature in the freshly gathered green material. This is often associated with another fault, the harvesting of the material in too mature a condition, a fault which was discussed in last month's notes. Usually sufficient heat has been developed in stored green material when it commences to sink down relatively rapidly—more rapidly than settling down due merely to the

weight of the material. As a rule, the changes in the green material which result in the production of high-quality silage have taken place when temperatures in the vicinity of 100° F. have developed. At times, and especially in stack silage, such temperatures develop within a day after the gathering of the green material, and in such cases the storing of the silage may proceed daily. But at other times, and particularly when leafy watery crops are being handled and during cold or wet weather, the rise in temperature may occur more slowly, with the result that it becomes advisable to allow two days, or even more occasionally, to elapse before more green material is added to that already in the stack or pit. On the other hand, if the material for silage is relatively dry and stemmy, and particularly if the weather is fine and warm, overheating is likely to occur unless additions are made daily to the green material already gathered. Usually daily additions of 4 ft. to 6 ft. in height, according to the condition of the green material, give good results. Development of heat is slower in pits and trenches than in stacks and slower in sappy leafy material than in stemmy material.

Haymaking.

The loss of valuable nutriment which is bound to occur in haymaking may at times be considerably reduced by good management. The loss, being largely invisible, often receives less consideration than it warrants, and it is likely that if farmers realized more fully how great the loss may be they would take more pains to reduce it. It was stated in a recent number of the *Journal of the Ministry of Agriculture* (England): "Even under good conditions at least 20 per cent. of the original dry matter of the grass is lost in the process of haymaking. . . . When bad weather occurs the leaching of the food nutrients by rain may account for the loss of 50 per cent of the dry matter, and when hay is stacked in poor condition further serious loss of nutrients and deterioration of feeding value occurs in the stack." There is no evidence or ground for believing that the position is substantially different in New Zealand from that in England.

Frequently, in an endeavour to have the haymaking coincide with a period of fine weather, the mowing is carried out too late, and an inferior hay, due to the stemmy character of the material, is necessarily secured. The advantages of mowing at the leafy, early flowering stage of the bulk of the material are so great that they warrant special measures in an endeavour to save the hay in good condition. Cocking is one of these measures. Over a considerable portion of the Dominion it is seldom possible to save a heavy crop of hay in really good condition without cocking. There is vital practical difference between a well-hearted and raked hay-cock and a mere heap. The heap becomes sodden when exposed to rain, but the efficiently built cock will shed much of the rain and be wet only on the outside. Cocking is particularly serviceable in the saving of lucerne and of clover hay of good quality.

If a period of rainy and unsettled weather occurs immediately after an area has been mown, then, within reasonable limits, the mown material should not be handled until fine weather seems to have returned; any handling that mown material receives increases the amount of nutriment washed out by the rain.

Convenience is only one of the matters which should be considered in selecting the site of a haystack. A good site is well drained and not unduly shaded in a way which is likely to reduce the drying influence of winds. A dry base for the stack should be secured by the use of such material as posts, rails, or branches of trees. High stacks have the advantage of giving a large amount of hay in proportion to the roof, but the task of raising hay to the top may become unduly great, especially when only manual labour is being employed. Relatively long narrow stacks are often to be preferred, because they favour the more ready drying and cooling of the material.

The best time to mow lucerne cannot always be determined by the flowering development. Safer guidance is provided in the development of basal shoots. When fresh shoots at the bases or crowns of the plants are about an inch long the lucerne should be mown.

General Cropping Work.

Over wide areas good results have been obtained consistently by sowing swedes in December. Almost invariably swedes are sown on land ploughed out of grass. This is quite sound practice in view of such diseases as club-root and dry-rot, and it is instructive to note that in the relatively few instances in the farmers' field competitions in which swedes followed swedes the resulting crops were generally comparatively poor. Where it is proposed to sow swedes after a previous swede or turnip crop it is advisable over wide areas in which club-root is common to use a variety such as Hernings, which has been shown to be resistant to club-root. It is also specially desirable not to employ an acid manure, such as superphosphate, alone, which favours club-root.

Apart from conditions in which there is reason to anticipate trouble from club-root, superphosphate is a good dressing for swedes; indeed, a dressing consisting of about two parts super and one part bone manure is widely used with good results at the rate of 2 cwt. to 3 cwt. an acre. It is well to bear in mind that super readily causes serious injury to swede and turnip seed if brought into close contact with it even for a short period. Apart from such injury, super is over wide areas the most efficient form of phosphate that can be used with these crops. The injury may be avoided by mixing super with an equal weight of carbonate of lime at least a week before sowing.

A standard practice which gives good results generally is to sow 8 to 14 oz. of swede seed per acre in rows 14 in. apart. The varieties of swedes which are popularly favoured are Superlative, Grandmaster, Masterpiece, and Magnum Bonum, with Hernings coming into prominence where club-root is a consideration of moment.

Chou moellier has justly gained considerable popularity during recent years. A characteristic of considerable moment is its marked resistance to club-root. Because of this resistance it may safely be made to follow swedes, rape, or turnips which were attacked by club-root. Chou moellier calls for high fertility; it demands a soil of the type which would suit cabbage. If it is desired to grow chou moellier on inferior soils their fertility should be inproved, farm-yard manure being an excellent dressing for this purpose. If sown in October or November on fertile soils chou moellier is well adapted to provide feed in late summer. For winter feeding the crop may quite well be sown in December. A suitable sowing is 1½ lb. to 2 lb. of seed to the acre broadcast, or ½ lb. to ¾ lb. in drills 2 ft. to 3 ft. apart. The plant responds well to liberal use of fertilizers such as a mixture of super and blood and bone in equal parts; 3 cwt. to 4 cwt. per acre of this mixture may usually be applied with profit, and such a dressing may often advantageously be supplemented with 1 cwt. of sulphate of ammonia. Chou moellier is less subject to attacks of disease than other members of the cabbage family. It is distinctly suitable for cows, pigs, and poultry. Quite a number of successful sheep-farmers favour it for carrying sheep through the winter.

Maize and millet, to provide green feed, and lucerne often may be sown advantageously in December. On many farms intertillage and thinning of root crops sown in October and November is work which is also well worth doing in December. Spraying of potatoes with bordeaux is widely advisable in the coming month.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Cultural Operations.

THE moderate rainfall experienced generally during October made it desirable to keep cultural operations well forward; failure to give this work due attention is often reflected in severe dropping of fruits during November. Insufficient moisture, and consequently the lessened amount of soil food available for growth, creates a competition between fruit and foliage. The necessity of conserving moisture by systematic working of the soil need therefore hardly be stressed.

Provision for the cover-crop will now be under consideration, and it may be suggested that where cropping with lupins has been carried out for several years, and where local conditions permit, it may be wise to consider a change.

Thinning of Fruit.

The requirement of all markets for more moderate-sized fruits and the limited demand for oversized will probably have the effect of a modification in thinning operations to meet this general demand. This may be permissible with some varieties of apples such as Gravenstein, Delicious, and Granny Smith, also young vigorous Jonathan trees that produce a proportion of oversized fruits, but with heavy-cropping varieties any extreme modification would be inadvisable.

Grafts.

It will still be necessary to look over grafts from time to time and suppress growths on the stock. Where failures have occurred it will be desirable to allow those growths on the stock advantageously placed to persist, so as to permit of their being budded in the autumn.

Spraying.

With the acquisition of a more intimate knowledge of the efficiency of certain of the fungicides used and the more protracted period of their adhesiveness, there is a likelihood of modifications in the spray programme being undertaken. In those orchards where trees are not advantageously planted, however, having poor drainage and lack of soil aeration, or where the initial expression of fungus spores in the spring may be delayed owing to weather conditions being unfavourable for spore development, it would be a doubtful policy to make any decided alteration in a programme that has been found to be satisfactory over varied seasonal conditions in the past. It may be suggested as good practice for the orchardist to make a survey of the results of his spray programme, having particular reference to the temperatures and rainy periods experienced to date, and the measure of success in control of both insects and fungi.

Spraying operations for the ensuing month will be continued on the lines indicated in previous notes. Should any special trouble develop, such as a severe attack of leaf-hopper, red mite, mildew, or black-spot on póme fruits, when combination sprays are necessary, it may be advisable to seek the advice of the district Instructor.

A good general spray for pome fruits to meet most conditions is the following: Lime-sulphur, ½ gallon plus 2 lb. to 4 lb. finely divided sulphur, to 100 gallons water; arsenate of lead, 1½ lb. to 100 gallons water; spreader, ¾ lb. per 100 gallons; nicotine sulphate (if necessary), 1 pint per 100 gallons.

In some locations where red mite is severe summer oil, 1–80 to 1–100, will be requisitioned. Care should be exercised that a period of ten to fourteen days elapses between applications of lime-sulphur and oil.

Early varieties of stone fruits will be receiving their final fungal spray about three weeks before harvesting. Mid-season and late varieties will probably still require the addition of nicotine sulphate where aphis is

troublesome and previous sprays have not been effectual; lime-sulphur 1 to 170 or colloidal 2 lb. to 100, is recommended in the latter instance: a weaker solution may be used in the former.

—*H. F. Frost, Orchard Instructor, Wanganui.*

Citrus Culture.

One of the most important operations in connection with lemon orchards is spraying for the control of the various diseases. Verrucosis and grey-scab can only be controlled by using bordeaux 4-4-40, and this should be applied at regular intervals, commencing as soon as the first fruits have set and repeating at intervals as required. In preparing the bordeaux care should be taken to have the correct blending of the two ingredients. In making up 40 gallons possibly the easiest and simplest way is to dissolve the bluestone into 36 gallons of water, and then slake the lime into 4 gallons and strain this slowly into the copper solution while the agitator is going. Do not dissolve the bluestone into, say, 4 gallons of water and the lime into 4 gallons, and then blend them together, adding the bulk of the water afterwards. It is necessary to dilute either the suspension or the solution first, and blend afterwards. Failure to get results is often caused through neglecting to blend the two ingredients together in the proper manner.

A summer insecticide for the control of scale, &c., will be necessary, and one of the summer oils can be used for this purpose. Where scale insects have been very troublesome two applications may be necessary in order to get a good control. These should be applied during the period of early growth.

Cultivation should not be neglected, as it is important to conserve all the moisture possible in case of a period of drought. A well-cultivated orchard during the spring and early summer reflects credit upon the owner, and the tillage is in many ways beneficial to the well-being of the trees.

A good look-out should be kept for any borer that may be in evidence and treatment given as indicated in the August notes.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Precautions against Vermin.

As the season has now arrived when hot weather may be expected, it is essentially a time when every effort should be made to prevent insect pests becoming established, for it is during hot weather that they are apt to show up and increase at an alarming rate. If these pests are not kept in constant check the health of the birds, as well as their egg yield, will suffer. The best method of dealing with vermin is to prevent them from making their appearance. This implies strict attention to cleanliness, the provision of good dust-baths, periodical spraying of the houses with strong disinfectant, and the application of nicotine sulphate to the perches.

Broody Hens.

Another detail that should not be neglected now is that of keeping the nest-boxes free from broody hens. To allow these birds to sit on the nests for days and weeks at a time not only encourages the presence of vermin, but also a loss in eggs and reduced profits. The houses should be visited nightly, and any birds found on the nests should be removed to the broody-coop. In this way the bird will usually lose the desire to sit in the course of a few days and will resume laying again in a minimum

of time. On the other hand, if the bird is not removed from the nest during the first stages of broodiness it may be a matter of weeks before a normal egg-laying condition is regained. A broody-coop should be made in three compartments, one section being allowed for each day's broodies. The bottom should be made of narrow battens about 2 in. apart and raised on legs about 8 in. from the ground. Thus, with a free circulation of air in the coop, the bird is unable to retain heat, and the broody fever soon becomes broken. The coop should be so arranged that the birds can secure their food and water from outside. The common cruel practice of starving the broody hen, or supplying her with a mere living diet should not be resorted to. If eggs are to be produced by her within the shortest period, ample food of a nourishing nature should be provided.

Marking Chickens.

There should be no delay now in marking the feet of chickens for age determination. It is the only safe means whereby the common mistake of disposing of young profitable birds at culling time, and retaining on the plant old unprofitable ones, may be obviated with certainty.

Care of Incubating Machines.

Many incubating machines, including even those of the most popular makes, are often condemned as unreliable because a uniform degree of temperature cannot be maintained in them. The explanation is often a simple one. It is that the screw-part of the connecting-rod between the thermostat and the arm carrying the disk, becomes bent, thereby making it impossible for the disk to respond as it should. The connecting-rod must be absolutely straight, otherwise the apparatus will not work with the necessary exactness. If there is any kink at all in the connecting-rod, the pull will not be direct, and therefore the disk will not rise and fall in complete harmony with the thermostat. Once the screw part of a connecting-rod becomes bent it can never be depended upon, and the only safe course is to take it out and put a new one in its place. No doubt carelessness is mainly responsible for connecting-rods becoming bent, as well as other parts of the regulating devices of incubators getting damaged beyond repair, and it may be the result of throwing things in a careless manner on the top of the machine during the off season.

It is surprising the number of people who fail to realize the amount of time and money that can be easily lost as a result of not giving their incubator proper care and attention when out of use. Instances could be multiplied where planned hatching operations have been upset or abandoned for the season because a duplicate for some damaged part could not be procured when required. The careful poultryman, as soon as the hatching season is over, thoroughly cleans and disinfects his incubators before putting them aside. The lamps as well as the burners are washed in boiling water, and the regulating appliances are disconnected and placed inside the machine. In this way there is not only the assurance that these parts will be in good working-order when required the following season, but the life of the incubator or brooder will also be greatly prolonged.

Non-absorption of Yolk in Chicks.

A correspondent reports that he secured a good hatch of chicks from his incubator, but that the great bulk of them died during the brooder stage through failure to absorb the yolk of the egg which is drawn into the body of the chick just before it leaves the shell. It is generally believed that failure to digest the yolk is due to feeding the chicks too soon after hatching, or to overfeeding during the first week. It is also often considered that breeding from overfat hens is responsible for the trouble. These factors may have some influence in regard to non-absorption of the

yolk, but experience goes to show that it is due more to improper incubation than to any other cause This is borne out to a great extent by the fact that the trouble is seldom found in chicks that have been hatched by the natural mother. There it will be found that the yolk in its sac is in a more or less liquid state, which enables it to run freely and finally become absorbed. With incubator-hatched chicks the chief weakness probably lies in having the temperature too high during the whole or part of the incubating period, thus causing half-baking of the yolk and rendering it incapable of absorption. Evidently this is what happened in my correspondent's case, as he assured me that the chickens referred to commenced to pip on the nineteenth day of incubation and were hatched out on the following day.

If such trouble is to be minimized it is of the first importance that every care should be taken to prevent an excessive degree of temperature at any time during the incubation process. It will usually be found that really good hatches of chicks, which prove easy to rear, are obtained only when all the hatchable eggs pip on the twentieth day and the hatch is cleaned up on the twenty-first day. The temperature at the level of the tops of the eggs on the tray should be about 102° F. the first week, 103° the second and third weeks, and 104° when hatching. If the breeding-stock are all right, the eggs fairly fresh, the thermometer kept on a level with the germs, which are always floating uppermost irrespective of the position in which the egg is resting, and yet the hatch comes too soon or too late, it is well to have the thermometer tested or to secure a new one.

How to test a thermometer: Place a clinical thermometer and the one to be tested in water at 100° F. Stir gently, adding slowly at the same time hot water, and observe the different readings. If the incubator thermometer reads, say, a degree lower or higher than that of the clinical thermometer it must be worked a degree higher or lower accordingly.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Artificial Increase.

MANY methods are in vogue relative to what is commonly termed "increase." The word in this case means adding to the number of colonies. Strong stocks are built up by early feeding, and then are divided, the portion containing the old queen being removed to a new location. As nearly as possible an equal part of brood and stores is given to each, and the remaining space is filled with frames of foundation. Early queens must be reared and introduced to the half that is queenless, or, failing this, a ripe cell should be inserted.

For rapid increase this method is perhaps the best known in bee-culture, and is highly recommended. Always remember a good spring is necessary to ensure the young queens mating in time. If a large number of colonies are required those already divided may be further fed with sugar syrup or sealed stores, until sufficient strength has been gained for a second division. Just here judgment is required as to whether some stocks are too weak for a second division, for only the very strong should be so broken down.

Queen-rearing.

During the summer months every attention should be paid to raising a stock of young queens to replace old and failing ones. Buying new queens each successive season is too expensive, and with a little attention and care good queens can be raised by the beekeeper in his own yard. An apiary should be requeened as a rule each year, and queens should not be tolerated for more than two seasons at the most. In the long run it is the queens that tell in the production of big crops, and unless the

beekeeper takes the trouble to requeen in the summer only a small proportion of the stocks will yield a surplus. Perhaps no branch of apiculture receives less attention than the production of young queens; and yet if the beekeepers who get the big crops of honey are asked what counts most in their production the reply is invariably "young queens." In New Zealand it has been proved over and over again that the best period for raising queens is from November to February. During these months everything is favourable for the operation, as the hives are at their highest state of prosperity, and under normal conditions the workers and drones are at their best.

It is best to breed only from pure Italian queens whose correct mating has been assured. Novices can judge the mating by noting the uniformity of the hatching brood as regards colour. Should the young worker bees show diversity of colour—some being yellow-banded and others quite black—the mating has not been correct. The question of mating is always a difficult one, as queens mate on the wing, and therefore it is impossible for the apiarist to select the sires. But as purebred queens, even though mismated, throw pure drones, it only takes a comparatively short time to eliminate crossbred drones from an apiary. There is, however, still the chance of contamination from other drones in the neighbourhood.

To sum up the matter: By persistently breeding from the best it is possible to achieve wonderful results, while under careless management, or, as is often the case, no management at all, bees are sure to deteriorate.

Methods of queen-rearing are legion, but may be roughly divided into two classes—namely, those which use the naturally built queen-cells, and those which necessitate the provision of artificial queen-cups into which young larvæ are transferred. The former method is most suitable for beginners, or for use early in the season, as it minimizes the risk of chill to young larvæ; while the second method is used largely by beekeepers who want to rear queens in greater numbers.

The Alley System.—A simple, efficient, and easy method for raising queen-cells may be found in the Alley plan. It must be understood, however, that when raising queen-cells they require to be large and well-shaped, and that any cells not up to size should be cut out. Procure a frame of young larvæ from the breeding-hive, and with a sharp knife proceed to cut every second row of cells down to the midrib of the foundation. Next kill two out of every three larvæ, and cut the comb into strips about 1 in. wide the full length of the frame. These strips are fastened with melted wax to cell-bars that hang about midway in a standard frame. The cells are pared down to about ⅜ in. in height, which gives the bees room to construct a solid base for the queen-cell. The frame or frames containing these bars, with the strips attached, may now be put into the hive previously prepared for their reception.

The Miller Method.—The Miller method of raising queen-cells will be especially useful to the novice or to the beekeeper wishing a few cells at one time. It is simple, easy, and under normal conditions never fails. No extra appliances are needed as previously described. Perhaps no better outline of the Miller system can be given than the original one which appeared in the *American Bee Journal* for August, 1912, as follows: "Into an empty brood-frame, at a distance of 2 in. to 3 in. from each end, fasten a starter of foundation about 2 in. wide at the top, and coming down to a point within an inch or two of the bottom bar. Put in the hive containing your best queen. To avoid having it filled with drone-comb, take out of the hive, either for a few days or permanently, all but two frames of brood, and put your empty frame between these two. In a week or so you will find this frame half filled with beautiful virgin comb, such as bees delight to use for queen-cells. It will contain young brood with an outer margin

of eggs. Trim away with a sharp knife all the outer margin of comb containing eggs, perhaps a few eggs next to the youngest brood. This you will see is very simple. Any beekeeper can do it the first time of trying, and it is all that is necessary to take the place of preparing artificial cells. Now put this 'queen-cell stuff,' if I may so call the prepared frame, into the middle of a very strong colony from which the queen has been removed. The bees will do the rest, and you will have as good cells as you can possibly have with any kind of artificial cells. You may think that the bees will start 'wild cells' on their own comb. They won't. At least, they never do to amount to anything, and, of course, you needn't use those. The soft, new comb, with abundant room at the edge for cells, is so much more to their taste that it has a practical monopoly of all cells started. In about ten days the sealed cells are ready to be cut out and used wherever desired."

Nucleus Hives.

In order to facilitate the work of queen-rearing a few nucleus colonies should be run in conjunction with every apiary. In these small colonies queens can be raised and cared for until they are mated and laying. It is an easy matter, once the queens are laying, to transfer them to the larger hives in the apiary.

The best style of nucleus hive to adopt is the four-frame one. This size will give the young queen a chance to lay once she is mated, and will, besides, hold sufficient bees to care for relays of queen-cells throughout the season. To form a nucleus colony take one frame of well-capped brood with adhering bees, and one frame containing honey and pollen, the remaining space being filled with an empty comb and feeder. If the number of bees on the comb is not sufficient to form a good cluster, one or two frames of young bees may be shaken into the nucleus, this being done to replace the field-bees which return to the old hive. Place the frame of brood in the middle of the hive and close the entrance until the following day, when the bees may be released. In the course of a day or two the small colony will settle down, and will then be ready to receive the first queen-cell.

Nuclei thus formed should be placed in a shady position until the bees are released. It is a good plan to set them a fair distance apart from each other and away from the main part of the apiary.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

As potatoes and other early crops are harvested, the land should be prepared for planting savoy and red cabbage, cauliflower and broccoli, brussels sprouts, leeks, and celery during the months of December and January.

Celery: Where the top-soil overlies a shingly open subsoil, and is overdrained in some instances at this season, celery should be planted out in prepared trenches. These are made 15 in. to 18 in. wide—the latter where it is intended to set a double row of plants. Lift out the black soil and place it neatly on each side of the trench in equal quantities; then dig the bottom well, and fill in with a rich mixture of decayed farmyard manure and soil; tread it firm, and finish off with 4 in. of good soil. This should bring the surface back almost to the original level. In two or three weeks, when the filling has settled down, it should be well watered shortly before it is intended to plant out. This should be done at the end of a dry spell, if possible, and just before a period when dull showery

weather may be expected. Prepare the plants by spraying them with bordeaux (this will not only prevent leaf-spot fungus, but also attack from slugs), and soak the boxes well with water the day before planting out. To do this lift the plants with a good ball of soil carefully, and plant them firmly 9 in. apart. Soak the trench well immediately planting is finished, remembering that celery is a water plant, and should never be allowed to become dry. In districts with a generous rainfall, and on land that is always moist but well drained, trenches are not necessary. The plants can be set out, in rich ground well prepared, in blocks of eight or ten rows 9 in. apart each way, with intervals between the blocks for access. This method is suitable especially for self-blanching sorts, or in rows 3 ft. or 4 ft. apart. The rows should lie north and south.

Brassicas: Where the brassicas—cabbage, kale, cauliflower, broccoli, brussels sprouts—are to be planted work in a good dressing of lime, and when the ground has settled set out the plants in dull weather, being careful to set them deep and firmly. While the plants are in the seed-beds prepare them for removal by spraying them with a mixture composed of three teaspoonfuls of nicotine sulphate, 2 oz. arsenate of lead paste, and 4 gallons water (rainwater for preference). Dilute each ingredient in a small bowl, and stir it well before stirring it into the bulk of the water, taking special care with the paste to see that it is all worked down into a smooth cream. This spray will prevent damage to the plants from the small green caterpillar larvæ of the diamond-back moth which eat holes in the leaves, and green aphides which suck the juices from the tender leaves of the heart of the plant, which they sometimes destroy completely. Fortified with this protection, the young plants have a much better chance of meeting their troubles successfully in the early stages of growth. If the beds are at all dry water them well the day before lifting the plants, and when planting out lift and handle the plants with the greatest care to avoid injury and wilting, and keep as many roots as possible intact. If this is done and the plants are properly packed in trays and placed in a cool shady position while awaiting transport, the serious losses often incurred will be avoided. Where large quantities are handled, or in instances where the plants have to be transported for some distance under difficult weather conditions, the roots should be puddled in a mixture of soot, clay, and cow-manure to prevent the plants drying out. If green aphis continues to be troublesome after planting out a little tobacco dust placed in the heart of each plant will make conditions so unpleasant for the pest that they will leave it. This danger only exists for the short dry period preceding the autumn rains.

Leeks: The leek is a most reliable crop which flourishes under almost all conditions. It is available over a long period; even well into the spring-time it retains its good qualities when many stored roots have to be discarded. In land rich in humus it should be planted out about 9 in. apart, with 15 in. between the rows. Plants about a foot high are best; trim the tops off lightly and set them in holes about 9 in. deep, made with a thick blunt dibble. Do not fill in the holes, just water the plants in; this method assists in developing a good length of blanched stems. The crop can remain in the ground until lifted as required.

Pests and diseases: If the summer should be dry there is danger of the potato-moth attacking the tubers, and plants should be protected by moulding them up with greater care. In the case of humid warm weather now, the late potato crop will be threatened with late blight, and a good bordeaux 4-4-40 spray should be applied and repeated after an interval of about a fortnight. At this season mildew is sometimes prevalent on vegetable crops of many kinds, and on its first appearance a liquid sulphur spray should be used. This is one of the many troubles harboured by some of the common weeds, which is another reason for their suppression, not

only in the crops but about headlands and odd corners. An easy method is to scythe them down before they seed. Yet another disease demands attention here, the bacterial wilt of kidney beans; there will undoubtedly be a considerable occurrence of this disease so difficult to control. Precautions that should be taken now are to avoid traffic through a crop while it is wet with dew or rain, to carefully burn infected plants, and to see that one does not carry infection on hands or clothing. The first visible sign of the trouble seems to be a light green or yellow spot with shaded outline on the leaf. The reddish lesions on the stems are very distinct, as are the raised pustules on the pods. Because of its infectious nature go through the crop frequently when it is dry, and carefully pull infected plants and burn them.

Small-fruit Culture.

The harvesting of strawberries, currants, raspberries, and other small fruits is now at its height, and in tarts or just with whipped cream and icing sugar they are daily "specials." On light land, especially in dry districts, a failing supply sometimes threatens. This may be overcome by spreading a light mulch of short strawy manure, lawn mowings, or something of the kind, and applying water freely.

Where land is being prepared for planting these crops during the autumn or winter, it is now probably carrying a crop of potatoes or other vegetables. Special care should be taken to cultivate the crop frequently so as to thoroughly clean the ground, as this will not only increase fertility but dispose of weeds, which are a serious menace where permanent crops are to be planted, particularly in the case of the strawberry crop.

The reports from the Cheshunt Research Station in England are always of interest to growers of tomatoes. An investigation concerning the reduction in yield of this crop by continuous cultivation in the same soil is reported in the last issue to hand. It shows that the reduction was least when the soil was maintained in a spongy and well-aerated condition. Crops improved after liberal soil treatment with green manures or plain straw. The straw was cut into short lengths and used at the rate of 6 tons per acre. After trenching it in, the ground was watered thoroughly and the usual fertilizers applied.

As a result of experiments for the control of tomato leaf mould, the following spray is recommended in the report: ⅛ oz. Shirlan paste (salicylanilide dispersed in water as a 50-per-cent. paste), ¼ oz. Agral 1 (a spreading agent), 1 gallon water. The powder, Agral 1, is sprinkled into the water and mixed by stirring vigorously. Afterwards the requisite amount of Shirlan paste is added and mixed by stirring it well. A second application of the spray should be given seven days after the first, and further treatment if necessary. When the materials become available a trial under local conditions will be of great interest.

As a catch-crop under glass before tomatoes lettuce was grown at Cheshunt successfully during the past four years. The young plants were set out in unheated houses during December (June here), leaving room to plant tomatoes between the rows. The lettuce crop was removed within four or five weeks of planting tomatoes. The tomato plants were not injured by the presence of the lettuce, and, indeed, seemed to grow rather better. Tomato rows there were at a distance of 18 in. and 27 in. alternately; setting the lettuce plants 9 in. apart, three rows were planted in each of the wider spaces and one row in each of the smaller.

The Homestead Garden.

Choisya ternata is an evergreen shrub from Mexico that is very generally planted in our gardens. As it is said to be rather susceptible to damage at low temperatures, it is usually planted in a warm sunny position with very

poor results, the growth is crowded and dwarf, and the bloom small and scanty. Seen recently in a moist border lightly shaded, the plants were large open bushes with a mass of starry shining white blossoms that was most impressive. Camellias of different colours planted close by had the same light graceful open habit and generous display of blossoms that is such a striking contrast to the crowded, stunted, sunburnt growth so common when planted in sunny situations. This is a mistake we have made with many tender plants.

Where spring-flowering bulbs have to be lifted, it should be done so soon as the foliage changes colour and comes away easily when pulled. Place the bulbs in shallow trays and put them in a cool airy shed to dry and complete their ripening. Bulbs in grass should be scythed and mown so soon as they are ripe.

Mildew fungus has been troublesome in the garden for many seasons; roses and delphiniums among other plants are commonly attacked during the summer. A liquid sulphur spray is the most suitable means of preventing the disease from spreading.

The grass-grub will now be emerging from the ground in the form of brown chafer beetles during warm summer evenings. In districts where this pest is numerous lawns may be protected by broadcasting arsenate of lead powder 1 oz. to the square yard, it should be well mixed with fine soil. This material destroys the young larvae as soon as they hatch out from the eggs that are laid. —*W. C. Hyde, Horticulturist, Wellington.*

FERTILIZER IMPORTATIONS: SEPTEMBER QUARTER.

FOLLOWING are particulars of importations of fertilizers into New Zealand for the quarter ended 30th September, 1932:—

Nitrate of soda: Chile, 190 tons. *Basic slag:* Belgium, 2,425 tons. *Char-dust and bone-char:* Australia, 20 tons. *Rock phosphate:* Ocean Island, 8,515 tons; Nauru Island, 53,320 tons. *Other phosphates:* United Kingdom 653 tons; Belgium, 404 tons. *Sulphate of ammonia:* United Kingdom, 2,320 tons; Canada, 180 tons. *Kainit:* Belgium, 40 tons; France, 25 tons; Germany, 27 tons; Poland, 105 tons. *Muriate of potash:* France, 5 tons; Germany, 60 tons. *Sulphate of potash:* Germany, 127 tons. *Other potash fertilizers:* France, 75 tons; Germany, 454 tons. *Sulphate of iron:* Australia, 2 tons. *Other fertilizers:* United Kingdom, 1 ton; Australia, 5 tons.

Correction: In the return for the June quarter, basic slag, 50 tons, shown as of French origin, should have been shown as of Belgian origin.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 22nd September to 3rd November, 1932, include the following of agricultural interest:—

No. 67819: Horse-shoe; D. P. Mahoney. No. 69223: Spraying-apparatus; D. R. Dowling. No. 69230: Manure-distributor; C. Oliver and R. T. Oliver. No. 67606: Fibre treatment; J. A. Douglas. No. 67658: Treating meat; W. A. Bowie. No. 67997: Composition for treatment of cows' teats; A. R. Thompson and E. I. Bullot. No. 68677: Milk-strainer; R. J. Carbines. No. 69244: Tying wool-bales; R. W. Monten. No. 64629: Three-way centrifugal separating-machine: J. E. Winsloe. No. 67467: Manure-distributor: E. C. Houchen. No. 69006: Cleaning wool; Frosted Wool Process Co. No. 69090: Disk plough; E. Reid. No. 69287: Pasteurizing-machine for dairy products; C. Doering and H. H. Doering. No. 67761: Drain-digger; E. W. Barnett. No. 67913: Handling wool; L. W. Bagley. No. 68065: Milking-machine; J. Taylor and Co., Ltd. No. 69256: Wool-baling press; F. A. A. Merchant and G. W. Dixon.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

"A CONSPECTUS OF RECENT AGRICULTURAL RESEARCH."

LORD BLEDISLOE'S CAWTHRON LECTURE.

It was a happy and fitting thought on the part of the Cawthron Institute authorities to ask Lord Bledisloe, our much esteemed Governor-General, to deliver the annual " Cawthron Lecture " this year, and the choice of subject was no less appropriate. It is indeed difficult to think of any one better qualified than Lord Bledisloe to present a survey of agricultural research such as that now under review. He combines long experience in arable farming, live-stock raising, fruitgrowing, &c., on his own establishments in England, with scientific agricultural training, and has had active many-sided associations with public agricultural interests. Moreover, during his residence in New Zealand he has made himself well acquainted with our special farming practices and problems.

Lord Bledisloe's general approach to his subject may best be indicated by the following extract from the introductory passages of the lecture :—

" In no field of scientific effort is there to-day a greater, an economically more fruitful, or indeed a more well-balanced advance than in that which we designate collectively as Agricultural. In none, however, is progress so feebly recognized or its enormous commercial value so unjustly and short-sightedly underrated. Adjustments of the world's fiscal and monetary abnormalities may produce, at least temporarily, definite ameliorative results. But scientific discovery, prudently applied, will prove more permanently effective, both in augmenting the volume and improving the quality of the products of the soil, and in reducing, without human injustice, the cost of their production, transport, and distribution. This fact was recognized at the recent Imperial Economic Conference in the unanimous and prudent decision to perpetuate the existence of the Empire Marketing Board (of which I was myself one of the foundation members, as representing British farmers). and to provide for the continuity of its grants towards scientific research. And this leads me to the subject which I have chosen for this lecture. It is perhaps not unfitting that it should fall to me, however ill-equipped, to attempt in 1932 a summarized survey of the most striking results of recent agricultural research. Five years have now elapsed since I had the honour of presiding in Westminster Hall over the first Imperial Agricultural Research Conference, the main outcome of which was the establishment of Bureaux (or clearing-houses) for the dissemination and exchange, throughout the Empire, of the clearly ascertained results of scientific investigation and experiment, affecting different branches and phases of commercial husbandry, and during the interval which has since elapsed I have endeavoured, so far as my official duties have permitted, to keep *au courant* with such discovery, or amplified knowledge, as has from time to time emanated from the chief centres of specialized research in other parts of the Empire, as well as from those situate in this Dominion. I shall endeavour this evening to collate, without any attempt at an exhaustive or comprehensive survey, some of those which appear most interesting and most valuable in their potential economic effects."

The survey is divided into thirty to forty titled sections, some of the more important of which are those on soils, fertilizers, grassland, pasture research, mineral deficiencies, dairy research, wool,

types and fertility of farm animals, growth and meat production, fruit research, and agricultural economics. Grassland and mineral deficiencies, as might be expected, are discussed at greater length than some other topics. Regarding grassland, Lord Bledisloe remarks that "there is no field of research and experiment more closely affecting New Zealand husbandry, and none in which New Zealand scientists and farmers have more skilfully pointed the way to the rest of the Empire." Dealing with mineral deficiencies, he refers to "experiments at the Rowett Institute based on pioneer work in this Dominion." Dr. Leonard Cockayne and Mr. B. C. Aston are specially mentioned as pioneers in connection with pasture research and soil problems.

Concluding his survey Lord Bledisloe records a general appreciation of New Zealand workers in the field of agricultural science in the following graceful words: "I desire to pay a sincere tribute of appreciation of their public-spirited and efficient labours to the little band of scientific investigators who, in this Dominion, and with somewhat meagre resources (rendered more meagre by the prevailing economic cataclysm) are conscientiously and assiduously adding to the stock of human knowledge, and thereby to the real worth of their country and of the world. I congratulate them, and I warmly wish them in the future the full fruition and success which their public-spirited labours richly deserve."

It is obviously unfeasible to comment here in detail on the many-sided matter of the lecture, nor will space permit of further quotations, however tempting. Our farmer readers and others are recommended to go to the source themselves.

The lecture, the full title of which is "A Conspectus of Agricultural Research, with some Reflections thereon," has been published by Whitcombe and Tombs as a booklet of some sixty pages, well printed on good paper, at the popular price of one shilling. As a most interesting and informative collation, written in plain language and with a minimum of technicalities, it should certainly have a wide general circulation.

BOOKS RECEIVED.

LAND VALUATION AND PRICES IN NEW ZEALAND. By I. W. Weston, M.Sc., Ph.D., Lecturer in Farm Economics, Canterbury Agricultural College, Lincoln. Whitcombe and Tombs, Ltd., Wellington, &c. 3s.

TAXATION CONCERNING THE FARMER. By D. M. Malloch, A.R.A.N.Z.; with an introduction by I. W. Weston, M.Sc., Ph.D. Whitcombe and Tombs, Ltd., Wellington, &c. 3s.

CATTLE FARMING in SOUTH AFRICA. By A. M. Bosman, Professor of Animal Husbandry and Dean of the Faculty of Agriculture, University of Pretoria. South African Agricultural Series, Volume X. Central News Agency, Ltd., Johannesburg, &c. 27s. 6d.

ROTHAMSTED EXPERIMENTAL STATION, REPORT FOR 1931. Lawes Agricultural Trust, England. 2s. 6d.

HEMP FIBRES: Twenty-fourth Report of the Imperial Economic Committee. H.M. Stationery Office, London. 6d.

San Jose Scale and Poplars.—The Orchard Instructor at Hastings, Mr. N. J. Adamson, reports: "In this district poplars have been discovered in several instances to be infected with San Jose scale (*Aspidiotus perniciosus*). The Lombardy poplar is used very extensively for orchard shelter in Hawke's Bay, consequently the matter of scale control becomes more difficult. In the past the poplar has never been suspected as a source of orchard infection, so this discovery may lead to the tracing of a good deal of orchard infection which could not be accounted for previously. Silver birch, which is also used to a fair extent for shelter, is also liable to scale infection.

WEATHER RECORDS: OCTOBER, 1932.

Dominion Meteorological Office.

OCTOBER was a particularly favourable spring month, the principal features of which were generally mild temperatures, a good rainfall in those districts where it was most required, and an absence of strong, drying north-west winds usually so prevalent at this time of the year. After a succession of dry, cold months, the rain came at a time when the soil was in an ideal condition to receive it, and, as a result, vegetation made phenomenal growth.

Rainfall.—The total rainfall was considerably above the average in the eastern districts of the South Island, parts of Canterbury having more than double the usual amount. It was also in excess over much of the Taranaki and Wellington Provinces, but elsewhere, except at isolated places, below normal falls were recorded. The deficiency was greatest in the Gisborne and Hawke's Bay districts in the North Island, and in Otago, Southland, and South Westland in the South Island, but even in these districts there were occasional useful falls.

Temperature.—Temperatures were nearly everywhere above the average, the departure being over one degree and, in places, up to two degrees in the North Island. In the South Island the western districts had much warmer conditions than usual, while in Otago it was slightly warmer; but in Canterbury it was again colder, although the difference from normal was nowhere great. No severe frosts occurred.

Sunshine.—Over the greater part of the Dominion sunshine was less than the average, the only meteorological stations with an excess being Auckland, New Plymouth, and Invercargill. The deficiency was small in the North Island and in Marlborough, but parts of Canterbury had particularly low aggregates.

Pressure Systems.—The month as a whole was free from severe widespread storms. During the first week an anticyclone ruled and fine pleasant weather was general. From the 7th to the 13th, a series of moderate westerly depressions crossed the Dominion and somewhat changeable weather was experienced, although rainfall during this period was confined chiefly to districts with a westerly aspect. After the 15th a succession of depressions, chiefly of cyclonic form, advanced over the Tasman Sea and New Zealand, and, except for a few brief fine intervals, the weather continued to be dull and unsettled until the 27th. Rain fell at times in nearly all districts, and between the 21st and 26th Canterbury received some heavy downpours with cold easterly to southerly winds. By the 28th the last of the series of cyclones had passed eastwards, and a westerly type of pressure prevailed from then until the close of the month. Rather widespread rain fell on the 29th, but on the 28th and the last two days the weather was generally fair.

Associated with a rather intense cyclone which moved across New Zealand on the 24th and 25th, there were thunderstorms in various parts of the northern and central areas of the North Island. A particularly sudden and heavy downpour of rain occurred in the Woodville district between 1 and 2 p.m. on the 25th. Also, between Warkworth and Mahurangi Heads on the morning of the same day, a tornado was experienced which unroofed buildings and uprooted trees in the district.

RAINFALL FOR OCTOBER, 1932, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average October Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	2·95	14	0·75	5·42
Russell	3·45	14	0·85	4·02
Whangarei	3·80	18	1·09	4·80
Auckland	3·33	16	1·25	3·72
Hamilton	2·31	13	0·53	4·67
Rotorua	6·57	17	1·41	5·24
Kawhia	4·44	17	1·01	5·18
New Plymouth	6·08	15	2·16	5·47
Riversdale, Inglewood	11·09	20	2·32	10·39
Whangamomona	8·06	13	1·21	8·45
Eltham	6·70	13	1·55	4·88
Tairua	4·80	15	1·22	5·86
Tauranga	3·78	14	1·02	5·31
Maraehako Station, Opotiki ..	4·18	17	1·02	5·30
Gisborne	1·31	10	0·63	2·70
Taupo	3·31	19	0·66	4·34
Napier	0·41	7	0·13	2·23
Hastings	0·41	8	0·13	2·18
Taihape	1·93	14	0·68	3·66
Masterton	2·44	10	0·95	3·30
Patea..	5·36	14	0·83	4·20
Wanganui	3·48	13	0·58	3·46
Foxton	2·17	11	0·54	2·98
Wellington	3·87	14	0·85	3·41
South Island.				
Westport	7·51	19	1·12	8·70
Greymouth	9·88	20	1·96	10·32
Hokitika	13·65	19	2·29	11·83
Ross	13·20	15	2·41	14·84
Arthur's Pass	17·80	13	5·38	20·48
Okuru	7·01	7	3·50	15·60
Collingwood	7·02	15	1·25	10·27
Nelson	4·60	15	1·29	3·49
Spring Creek	4·19	18	1·27	2·50
Hanmer Springs	5·51	9	1·60	3·87
Highfield, Waiau	5·03	10	1·82	2·74
Gore Bay	5·96	10	2·18	2·11
Christchurch	4·96	12	1·13	1·69
Timaru	3·24	10	1·41	1·92
Lambrook Station, Fairlie ..	3·31	11	0·99	2·02
Benmore Station, Clearburn ..	3·11	9	1·38	2·27
Oamaru	3·04	13	1·02	1·73
Queenstown	1·46	9	0·40	3·41
Clyde	1·52	6	0·72	1·62
Dunedin	1·97	10	0·82	3·12
Wendon	1·80	8	0·55	2·79
Gore	1·68	14	0·41	3·28
Invercargill	1·53	11	0·54	4·50
Puysegur Point	5·86	17	1·27	8·26
Half-moon Bay	2·39	16	0·53	5·32

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.

RIDDING YOUNG PASTURE OF DOCKS.

A. T. BILKEY, Buckland :—

Can you advise me of a satisfactory method of getting rid of docks in a young permanent pasture ?

The Fields Division :—

Docks in young permanent pasture can be gradually diminished by the following methods : (1) Heavy top-dressing to strengthen the grass and clover plants, so that their increased growth tends to smother the dock. (2) Systematic grazing and spelling ; the pasture should be spelled as long as possible between grazings, commensurate with good utilization of the stock employed. (3) The grazing-down should be as rapid as possible ; day and night grazing with as large a number of stock as possible should be adopted. (4) Avoidance of close grazing. (5) Preventing the docks forming seedheads. Docks thrive best where the pasture is kept continually bare, allowing their leaves to lie flat on the ground. The methods of grazing advocated above, besides being of value in crushing out the docks, are also those most suitable to adopt in improving the pasture and the pasture growth.

JAPANESE MILLET FOR ENSILAGE.—LIME AND PUMICE SOILS.

" SUBSCRIBER," Wairoa :—

Please advise me on the following questions : (1) Would a crop of Japanese millet be suitable for making silage ? (2) Which would you recommend for pumice land—carbonate of lime or burnt lime ?

The Fields Division :—

(1) Japanese millet is not preferred for making silage, one of the chief reasons being that the stems are hollow, and owing to the presence of air the resultant silage is usually of poor quality. If millet is available and must be used, it is suggested that it should be mixed with material from a pasture containing plenty of clover. This method would aid in producing a better-quality silage, and a superior balance between carbohydrates and protein from a feed-value point of view.

(2) Pumice soils appear to vary in their response to lime in different localities, and so far little or no difference is noticeable between the effects of carbonate and burnt lime. The question mainly centres round that of cost. Approximately double the quantity of carbonate of lime is required to that of burnt lime.

CHICKEN WITH MALFORMED BEAK.

" AMATEUR," Auckland :—

One of a brood of healthy Rhode Island chicks I have found to have a crossed beak. The lower half of the beak protrudes ¼ in. beyond where the upper half crosses it, thus making feeding difficult. Can the fault be remedied ?

The Chief Poultry Instructor :—

Little or nothing can be done in such a case as this. A bird with a malformed beak should never be kept, as this defect prevents it keeping that provision of nature, the little oil-well at the root of its tail, clean and in working condition. The well dries up and becomes a home for insect life, and the bird, being unable to obtain oil for pluming itself or to use its beak for picking insects off its body, becomes a prey to parasitic life, and is not only in a state of torture itself, but spreads vermin wherever it goes.

The New Zealand

Journal of Agriculture.

VOL. 45. WELLINGTON, 20TH DECEMBER, 1932. No. 6.

SOILS OF THE NEW ZEALAND SEA LITTORAL AND THEIR PLANT COVERING.

B. C. ASTON, Chief Chemist, Department of Agriculture.

THE classification of soils on a continental scale is usually based on the situation with reference to climate and its effects ; on a smaller scale the classification rests more on the physical or chemical properties of the soils. The coastal districts of New Zealand, and those owing their warmth to the proximity of the sea, have a similarity of climate which enables this important factor to be disregarded generally. The great majority of New Zealand soils fall into the second of two great classes proposed by the Russian school of soil chemists (Glinka and others), the skeleton, immature, or mineral soils, of which very little is known. In other words, in New Zealand the particles composing the soil have been insufficiently weathered since the time they were broken from the parent rock, to which the soils are more akin than to those mature soils of the continents.

Of the physical and chemical characters—since the majority of New Zealand soils are derived from but a few rocks such as the greywacke and the volcanic rocks, well supplied with plant-food—the physical state of the soil which determines the capacity for holding water is of superior importance to the knowledge of the plant-food content. In other words, whether a soil is a fine gravel, a coarse sand, a fine sand, a clay, or a mixture of these usually called a loam, is what as a rule determines soil value to the farmer. The dictum of Sir Daniel Hall and Sir John Russell that "in the main it is the structure of the soil as revealed by the mechanical analyses which determines the adaptability of the soil to a given crop" should be the guiding light in New Zealand soil studies.

Obviously a third method for determining the quality of soils should be available in which the various forms of life which occur in the soil or grow on it are taken into account as indicators of the quality of the medium from which they draw their food, except carbon in the case of the higher plants. The study of microflora and microfauna of soils is in its infancy, and nothing can now be said as to the value of these low forms of life in diagnosing the quality of

fertile soils. The value of the higher plant covering as a means for determining the agricultural possibilities of lands was pointed out by Hilgard in his classic work on American soils (1906), in which a chapter is devoted to "The Recognition of Character of Soils from their Native Vegetation." Original survey maps of the New Zealand Lands Department always show the kind of forest growing upon lands surveyed by the Government, and undoubtedly the plant covering has been taken into account in assessing the probable value of land for settlement. In the 1907 Report of the Department of Agriculture, the writer stressed the importance of taking the plant covering into account in any systematic research on soils, and in the 1909 Report, p. 457, referred to a flying soil survey in the sub-Antarctic islands of New Zealand where the soils are differentiated by means of the plant covering (see this *Journal*, Jan., 1911, p. 10). Here was given in some detail the results of the survey, indicating that the plant covering is a sure guide to the qualities of the soil in the Lord Auckland Islands (see "Sub-Antarctic Islands of New Zealand," Government Printer, 1909).

Again, in the soil survey of the Patatere Plateau, north-west of Rotorua (see this *Journal* for June, 1926, p. 365), on a large area of country having similar topography and climate, it was possible to correlate soil texture with primitive plant covering which in this case was forest, the usual climax of vegetation, tawa-rimu forest, occurring on the coarser soils, and beech forest on those which had a larger proportion of fine particles.

In the following pages it is intended to deal with the characters of sea littoral soils which as a class present many points of theoretical and practical interest. Littoral pastures are well known to provide better grazing than inland pastures on the same kind of soil, and the reason for this is worthy of a passing thought. It will be found on examination that land plants which succeed in growing in situations which at any time may be charged with salt water from the sea, and at all times are exposed to strong light and often to heavy winds, have adopted special contrivances which enable them to tide over periods of saltness or dryness of soil or air until these conditions disappear.

The exact means by which plants are able to tolerate a large quantity of salt in the soil need not be discussed, but it will be sufficient to say that the most prominent sign of the sea littoral plant is extreme succulence of habit due to storage organs containing water, which enables the plant to exist without taking up the salt water in the soil surrounding the plant roots. The soil is then said to be physiologically dry, or, to put it another way, on seashores the water may be at times unavailable to the plant owing to saltness, while in deserts there is deficiency of water of any kind, fresh or salt. Other structural adaptations which enable plants to tide over a period of adverse dry conditions are extreme leatheriness of leaf texture or great hairiness of leaf surface, both resorts of the plant to diminish transpiration from the tissues of water, which is hence better conserved. The plants which can only produce thin large leaves adapted to transpire copiously are never found in the vegetation of maritime shores where they may be exposed to excessive salt, strong insolation, and drying winds.

It should be here pointed out that salt blown inland as sea spray has a short life in the soil, even when quite near to the sea, and the soil on analysis will show very little contained salt. This is due to the fact that, in addition to the loss by leaching in the drainage, moderate doses of salt are changed in the soil, where a double decomposition of soil-matter and salt takes place, so that little chlorine is found on analysis. A number of plants which are regarded as sea littoral plants entirely are found on the shores of the great lakes, and also in inland situations, where they have adapted themselves to the new environment completely. Thus *Selliera radicans, Ranunculus acaulis,* and *Calystegia Soldanella* grow on pumice beaches in the North Island lakes, while the last named may be observed growing quite well in railway ballast on the railway-line near Upper Hutt station, the seeds having evidently been transported from the coast in the gravel.

Common salt (sodium chloride) is undoubtedly able to liberate plant-food from the inert silicates of the soil, which, after being acted upon by the carbonates of soda probably formed, is decomposed into compounds more available to the plants. There is evidence that in this way phosphates are attacked and rendered more soluble in weak citric acid and leached out of the soil. Potash certainly is liberated and no doubt calcium, while iron is leached out and redeposited as a pan or hard layer. Sodium carbonate acts as a deflocculating agent enabling the finer particles to be washed away and deposited elsewhere. General increase of the mineral fertilizer elements would no doubt lead to increase of the available nitrogen in the soil, hence result in better pasture. The presence of salt in the soil is inimical to many pests that feed on plants. On the whole, therefore, salt in the right quantities may be extremely beneficial to land when the type of soil is a light one. On clays and heavier soils the action of salt may be injurious. If, however, the amount of salt in the soil is very large—for instance that introduced by intermittent submersion by tides and the subsequent drying-out of the water—the salt accumulates to such an extent that only purely halophytic plants such as salt-weed (*Salicornia*) can grow on it.

Plant Indicators.

In the North Island there is current among experienced farmers who have had the opportunity of observing the "breaking-in" of various types of country, a tradition (which will be dealt with at length later) concerning the quality of the soil as indicated by the primitive plant covering. Thus totara (*Podocarpus totara*) is an indication of stony soil and subsoil, but matai (*Podocarpus spicatus*) is always found on rich land and is a sign of dry land when growing in close stands. Pukatea (*Laurelia novæ-zealandiæ*) is a sign of good land, but perhaps one of the best indicators of good land is mahoe (whitey wood) (*Melicytus ramiflorus*). Perhaps the best sign of all in indicating goodness of land is the New Zealand vine or Pohuehue (*Muehlenbeckia australis*) when present in abundance. Supplejack (*Rhipogonum scandens*) is another liane which also betokens superior quality of soil. On the other hand, rimu (red pine) (*Dacrydium cupressinum*) is a sign of sour land. Tawa (*Beilschmiedia tawa*) indicates good land when the leaves are a healthy and bright green colour, but when the leaves are yellowish it often

signifies poorer quality soil, tawa being the predominant tree of much of the forest-clad pumice lands. Kahikatea (white pine) (*Podocarpus dacrydioides*) betokens swampy conditions. Tawhero (*Weinmannia racemosa*) and beech (*Nothofagus* sp.) are indicative of much poorer land than occurs with Podocarp-tawa forest, and when cleared the land is left in bad condition, and grass will not grow well for five years or so. Certain other plants show mildness of climate; passion-flower (*Tetrapathoea tetrandra*), nikau palm (*Rhopalostylis sapida*), puriri (*Vitex lucens*), and New Zealand mahogony (kohekohe) (*Dysoxylum spectabile*) always occur where there is very little frost. In the far North, kauri forest indicates the poorest soil, but tall manuka is evidence of good land.

A host of plants are characteristic of the sand dunes, and have evolved a habit of growth necessary to guard against premature burial by the wind-blown particles. The truth that marsh swamp or bog plants indicate wet soil is too obvious to be stressed.

In the case of sea littoral soils there appears to be a distinct gradation in the tolerance which land plants exhibit towards soils containing varying proportions of salt. Thus nearest to the salt water of tidal inlets, on land subject to periodical submergence by sea water at times of exceptional high tides, grows the salt weed (*Salicornia*). To the landward of this, very often closely associated, are such plants as *Scirpus maritimus* or *Chenopodium glaucum*, and as the salt diminishes *Cotula coronopifolia* and many other plants are ready to occupy ground only slightly salty, such as the introduced sow-thistle (*Sonchus* sp.), &c. Evidently this is another case of change of chemical composition of soil being indicated by a change in the plant covering.

Perhaps the most striking instance of the influence of soil composition on the vegetation is that of the Dun Mountain, Nelson, where the change from beech forest to scanty scrub is coincident with the great change in the magnesia content of the soil (see this *Journal*, December, 1915, p. 500, and Bulletin 12, Geological Survey, p. 5.).

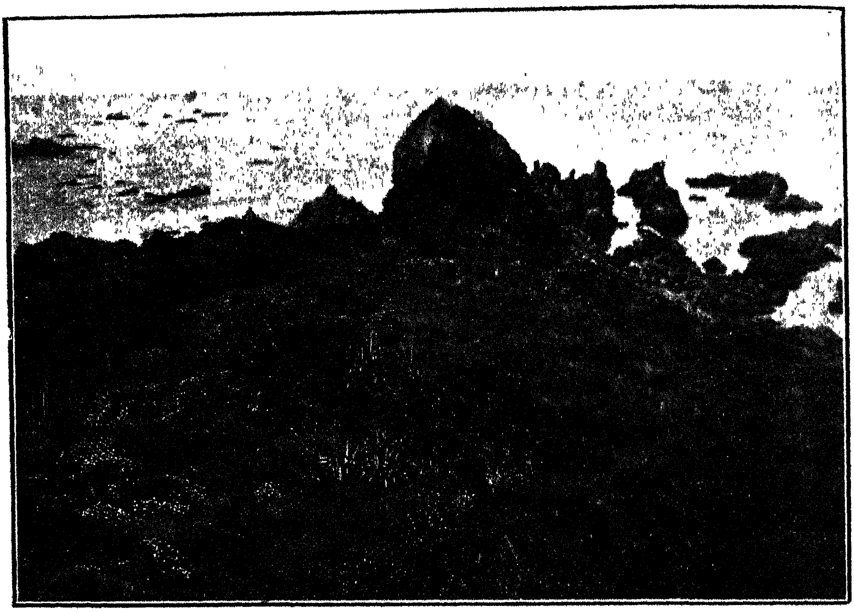
Naturally this method of diagnosis of soil quality from an inspection of the land covering is best performed in primitive areas where the competition between plants has been going on for ages without interference by man. Recently the question has been asked why certain areas of scrub lands on the Kaingaroa Plains are populated by monoao (*Dracophyllum subulatum*) in pure association and other areas nearby by an entirely different mixture of shrubs, a most striking difference even to the casual observer passing by. This is probably more a frost effect than one due to soil change, the monoao often occupying depressions. Similar changes in adjacent districts in vegetation have also been noticed which can only be due to frost effect.

The littoral soils about Wellington may be best studied on the small spray-swept islands, whether these occur in the harbour or outside. These all exhibit a similarity of an indigenous plant-covering which would enable a skilled observer to say that the area was a typical littoral soil, and analyses of the soil would show that the plant-foods were present in higher proportions. All the following islands have been carefully inspected and a note taken of their florulas: Kapiti and its outlying islands—Motungarara or Hiko Island (*m*), Tokomapuna or Evans Island (*e*), Tahoramaurea or Mayhew Island (*t*); Mana

Island; the islands in Wellington Harbour—Somes Island and its outlying islets, Ngamokopuna or Leper Island (*n*), Ward Island (*w*), Taputurangi or Island Bay Island (*i*); Stephens Island in Cook Strait. Following is a list of the plants common in each of these smaller islands, which from their limited area and exposed position afford good opportunity for studying the results of sea spray, intense sunlight, and wind action. The letters placed after the name of each plant indicate the names of the different islands (as named above) on which it occurs. The larger islands—Kapiti, Mana, Somes, and Stephens—are omitted, as they are so comparatively extensive and partially forested that they probably escape in great part the unusual conditions which affect the vegetation on the smaller islands.

Ranunculus acaulis : *m, n.*
Cardamine hirsuta : *i, t, m, e.*
Hymenanthera crassifolia : *m, i, n, e.*
Colobanthus Muelleri : *i, w, n.*
Spergularia media : *m, e, i, n, w.*
Linum monogynum : *m, e, i, n.*
Acæna sanguisorbæ : *m, w.*
Tillaea Sieberiana : *e, m, t, i, n.*
Haloragis alata : *m, n, e.*
Mesembryanthemum australe : *m, e, w, i, n.*
Tetragonia trigyna : *m, e, w, i.*
Hydrocotyle moschata : *t, w, m.*
Apium prostratum : *m, e, w, i, n.*
Coprosma Baueri : *w, n, i, m.*
Coprosma propinqua : *e, m, i.*
Gnaphalium luteo-album : *m, w, n, i.*
Cassinia leptophylla : *m, t, w, n, i.*
Craspedia uniflora : *n, i.*
Cotula coronopifolia : *m, n, i.*
Cotula australis : *t, m.*
Senecio lautus : *m, e, n, w, i.*
Sonchus asper (*var.* littoralis) : *n, w, i.*
Selliera radicans : *n, i.*
Lobelia anceps : *n.*
Wahlenbergia gracilis : *n, m.*
Samolus repens : *i.*
Calystegia Soldanella : *m, e, n.*
Dichondra repens : *n, e, w.*
Veronica salicifolia (*var.* Atkinsoni) : *n, w, m.*
Myoporum laetum : *m, e.*
Scleranthus biflorus : *m, n.*
Rhagodia nutans : *m, e, w, n, i.*
Salicornia australis : *m, e, w, n, i.*
Muehlenbeckia complexa : *m, e, t, w, n, i.*
Pimelea laevigata : *m, n, i.*
Phormium Cookianum : *m, t, n, i, e, w.*
Juncus effusus : *w, n, i.*
Luzula sp. : *m, t, n, w, i, e.*
Mariscus : *e, t.*
Scirpus nodosus : *t, e, m.*
Carex pumila : *e, m, w, i.*
Microlena stipoides : *t, m.*
Deyeuxia Billardieri : *n.*
Dichelachne crinita : *m, e.*
Trisetum subspicatum : *i, w.*
Poa anceps : *m, e, n, w.*
Poa caespitosa : *m, e, w, i.*
Festuca multinodis : *n, i.*
Agropyrum scabrum : *m, e, n, i.*
Asplenium obtusatum : *w, m.*
Asplenium flaccidum : *m, i.*
Aspidium Richardi : *i.*
Polypodium serpens : *m, w, i.*
Polypodium Billardieri : *w.*

Thus in this list, although every plant is adapted by texture of leaf, succulence, hairiness, leatheriness, glaucescence, or spinescence, or a combination of these characters, to withstand drought, the individual species may often be found far from the sea on mountain tops or rock faces on the hills, by fresh water lakes, or in any situation where the light-demanding nature of the plants can be satisfied. While, therefore, the physiognomy of the coastal vegetation is recognizable as such, it is only by such plants as the sea celery (noted by Captain Cook as "sellery"), *Apium prostratum, Carex pumila, Colobanthus Muelleri, Hymenanthera crassifolia, Mesembryanthemum australe, Rhagodia nutans*, New Zealand spinach (*Tetragonia trigyna*), *Spergularia media, Sonchus asper* (var. *littoralis*), and *Salicornia* that the observer can be certain that he is dealing with a sea-marginal vegetation. Of all these plants *Salicornia* is the one most restricted to a salty situation, and if the salt is removed it is soon smothered by quicker-growing vegetation. Species of this genus occur in many parts of the world, have the same faculty for enduring salt, and are as reliable indicators of its presence as the New Zealand species.



TYPICAL PLANT COVERING ON TOKOMAPUNA, AN OUTLYING ISLAND OF KAPITI.

ACTION OF WIND-BORNE SEA SALT.

There is no doubt that where large quantities of salt are carried ashore in the sea winds a solvent action on the soil phosphates is exercised so that these are leached down into the subsoil, where under certain conditions they are deposited as a hard-pan with the iron and other elements which form these pans in the subsoil. Both at the Bluff, Southland, and at Campbell Island samples of pans have been analysed showing over 1 per cent. of phosphoric acid (see 1909 Annual Report of Agriculture Department, p. 470, Chemistry Section).

Ohau Bay, next to Te Kaminaru Bay, is a narrow valley running north and south on the Makara side of the Wellington Peninsula. The bay, therefore, faces the track of the strong north and north-westerly gales off the Tasman Sea which must carry large quantities of salt ashore as spray. The valley behind the bay is shut in by high hills, but the valley floor is smooth and rises very gradually for about a mile, being under pasture. There is therefore here an opportunity for examining the effect of salt on soil and subsoil. Samples were drawn at the bay immediately behind the boulder beach and at every quarter mile inland, with the results given in Nos. K/3025–3032 of the accompanying table of analyses. The leading features disclosed by these analyses are the influence of salt in leaching phosphates from the soil to the subsoil, the accumulation of magnesia, the high availability of the phosphate left in the topsoil, and the great increase in the potash content. It will be noticed that only the area sampled nearest the sea shows any abnormality in the available phosphoric

Chemical Analyses of Sea Littoral Soils.

Results, except *, are percentages on soil dried at 100° C.

Laboratory No.	Locality.	Volatile Matter.			Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method, Hall's Modification. ("Available Plant-food")				Hydrochloric-acid Extract. ("Total Plant-food.")				Lime-requirement, %CaCO3.		Other Details.
		* On Air-drying.	* At 100° C.	On Ignition.		Lime, CaO.	Magnesia, MgO.	Potash, K2O.	Phosphoric Acid, P2O5.	Lime, CaO.	Magnesia, MgO.	Potash, K2O.	Phosphoric Acid, P2O5.	On Air-dried Soil.	On Soil dried at 100° C.	
K/2262	Bluff, Southland, virgin tussock land	..	5·02	..	0·78	0·16	0·15	0·030	0·035	0·56	0·33	0·16	0·27	..	..	..
K/2263	Bluff, Southland, subsoil of K/2262	..	3·74	..	0·18	0·18	0·14	0·017	0·023	0·67	0·37	0·14	0·19	..	..	..
K/2621	Centre Island, Foveaux Strait	..	12·00	..	0·63	0·07	0·05	0·014	0·060	0·33	0·20	0·10	0·31	..	..	..
K/2658	Bluff, Tiwai Point	..	7·06	..	1·26	0·50	0·23	0·030	0·030	1·12	0·54	0·07	0·23	..	..	..
K/2659	Bluff	..	8·28	..	1·24	2·09	0·15	0·030	0·200	4·52	0·49	0·13	0·66	..	..	..
K/2768	Bluff Hill, below reservoir	..	3·30	..	0·21	0·07	0·03	0·010	0·010	0·22	0·13	0·09	0·07	..	..	..
K/2769	Bluff Hill, subsoil of K/2768	..	2·38	..	0·11	0·07	0·03	0·010	0·010	0·26	0·16	0·08	0·07	..	..	..
K/2622	Puysegur Point, Fiord County	..	2·60	..	0·16	0·00	0·06	0·010	0·020	0·20	0·20	0·08	0·09	..	..	..
K/2623	Resolution Island, Fiord County	..	46·60	..	2·20	0·56	0·26	0·015	0·020	1·50	0·19	0·05	0·20	..	..	..
K/2624	Resolution Island, subsoil of K/2623	..	13·50	..	1·82	0·18	0·11	0·010	0·010	0·50	0·11	0·03	0·12	..	..	..
K/2626	Supper Cove, Fiord County	..	5·54	..	0·28	0·24	0·10	0·040	0·020	0·64	0·84	0·12	0·13	..	..	..
K/2627	Snug Cove, Fiord County	..	8·92	..	1·00	0·08	0·06	0·030	0·020	0·48	0·29	0·07	0·09	..	..	..
K/2628	Caswell Sound, Fiord County	..	11·66	..	1·60	1·50	0·18	0·030	0·040	4·72	0·16	0·13	0·13	..	..	..
K/2629	Anita Bay, Milford Sound	..	14·64	..	0·92	0·17	0·47	0·030	0·040	0·56	2·55	0·05	0·09	..	..	..
K/2631	Milford Sound	..	6·48	..	0·15	0·06	0·03	0·010	0·040	0·57	0·67	0·06	0·15	..	..	..
K/2632	Milford Sound	..	3·04	..	0·31	0·05	0·04	0·010	0·030	0·28	0·47	0·04	0·10	..	..	..
K/2633	Milford Sound, subsoil of K/2632	..	1·80	..	0·10	0·04	0·02	0·005	0·090	0·33	0·56	0·06	0·19	..	..	..
K/2634	Milford Sound, Sandfly Point	..	4·88	..	0·22	0·04	0·04	0·010	0·050	0·22	0·62	0·06	0·21	..	..	..
K/2635	Milford Sound, subsoil of K/2634	..	1·49	..	0·17	0·05	0·04	0·010	0·020	0·26	0·72	0·06	0·18	..	..	..
K/2636	Bowen Falls, Milford Sound	..	3·47	..	0·07	0·15	0·05	0·010	0·110	0·36	0·60	0·09	0·26	..	..	..
K/2637	Cone Island (primitive)	..	12·98	..	2·25	0·07	0·07	0·010	0·130	0·20	0·20	0·15	0·76	..	..	..
K/2638	Cone Island (primitive)	..	16·06	..	1·70	0·09	0·07	0·010	0·130	0·26	0·25	0·18	0·58	..	..	..
K/2639	Cone Island (primitive)	..	6·61	..	0·91	0·01	0·05	0·010	0·250	0·21	0·16	0·14	0·79	..	..	..
K/2640	Cone Island (primitive)	..	2·44	..	0·20	0·03	0·03	0·010	0·360	0·32	0·29	0·17	1·09	..	..	..
A/1183	Topsoil, Chatham Islands	..	..	96·87	..	..	..	..	..	0·78	0·70	0·07	0·005	..	..	Samples A/1183–84 ashed prior to extraction.
A/1184	2nd grade topsoil, Chatham Islands	..	5·34	88·28	..	..	..	..	..	0·44	0·46	0·04	0·003	..	..	Humus soil.
A/1185	Subsoil, Chatham Islands	..	0·18	1·24	0·039	..	..	..	..	0·16	0·17	0·02	Nil	..	..	Coarse sand.
B/873	Great Mercury Island	19·2	2·20	14·90	0·338	0·098	0·123	0·021	0·002	0·34	0·64	0·11	0·05	0·34	0·35	p. H, 5/5.
B/874	Great Mercury Island	17·2	3·00	14·40	0·403	0·129	0·131	0·025	0·002	0·40	0·54	0·12	0·04	0·24	0·25	p. H, 5/8.
B/875	Great Mercury Island	21·1	3·00	16·50	0·330	0·171	0·190	0·024	Trace	0·51	0·92	0·09	0·05	0·25	0·26	p. H, 6–0.
G/499	Turanganui, Palliser Bay	..	14·47	7·45	0·184	..	..	0·028	0·006	0·33	0·40	0·37	0·05	..	..	..
G/801	Te Kaminaru Bay	2·0	2·38	6·75	0·224	..	..	0·037	0·039	0·42	0·40	0·33	0·10	..	..	..
K/3025	Ohau Bay, Terawhiti	..	5·88	9·94	0·448	0·09	0·070	0·030	0·010	0·48	0·62	0·34	0·17	..	..	Farthest from sea.
K/3026	Ohau Bay, subsoil of K/3025	..	2·76	4·60	0·140	0·05	0·030	0·010	0·010	0·46	0·54	0·28	0·08	..	..	..
K/3027	Ohau Bay	..	1·56	5·80	0·280	0·04	0·030	0·010	0·010	0·52	0·18	0·05	0·04	..	..	Nearest to K/3025.
K/3028	Ohau Bay, subsoil of K/3027	..	1·60	2·34	0·216	0·03	0·020	0·010	0·010	0·42	0·22	0·08	0·04	..	..	..

CHEMICAL ANALYSES OF SEA LITTORAL SOILS—*continued.*

Results, except *, are percentages on soil dried at 100° C.

Laboratory No.	Locality.	Volatile Matter.			Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method, Hall's Modification. ("Available Plant-food.")				Hydrochloric-acid Extract. ("Total Plant-food.")				Lime-requirement, % $CaCO_3$.		Other Details.
		* On Air-drying.	* At 100° C.	On Ignition.		Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	Lime, CaO.	Magnesia, MgO.	Potash, K_2O.	Phosphoric Acid, P_2O_5.	On Air-dried Soil.	On Soil dried at 100° C.	
K/3029	Ohau Bay	..	1·86	5·36	0·168	0·03	0·030	0·010	0·010	0·42	0·08	0·08	0·04	..	..	Nearest to K/3031.
K/3030	Ohau Bay, subsoil of K/3029 ..		1·26	4·14	0·140	0·04	0·020	0·010	0·010	0·30	0·10	0·07	0·03	..	..	..
K/3031	Ohau Bay	..	2·84	8·00	0·182	0·04	0·020	0·010	0·030	0·44	0·18	0·09	0·14	..	..	Nearest to sea.
K/3032	Ohau Bay, subsoil of K/3031 ..	..	3·44	6·88	0·214	0·03	0·030	0·010	0·070	0·34	0·14	0·08	0·21	..	..	..
K/11–14	Titahi Bay, hill soils, mean of 4 ..	..	3·89	6·84	0·247	..	..	0·017	0·008		..	..	..	..	..	..
J/1054	Titahi Bay, swamp soil	..	6·20	12·65	0·388	..	..	0·018	0·118	..	..	..	..	..	..	..
J/1055	Titahi Bay, swamp soil	..	22·30	33·44	1·144	..	..	0·017	0·045	..	..	..	..	..	..	..
J/892	Titahi Bay, salt meadow (primitive)	..	1·86	5·89	0·171	..	..	0·030	0·024	..	..	..	..	..	..	0·24 % NaCl.
J/638	Titahi Bay, Cervantes Point ..	..	2·00	4·75	0·186	..	..	0·008	0·049	..	..	..	..	..	..	Alkaline, sandy.
J/639	Titahi Bay, ...	..	8·26	8·80	0·373	..	..	0·007	0·039	..	..	..	..	..	..	..
J/26	Titahi Bay, hill soil		3·00	8·06	0·375	..	..	0·024	0·061	..	..	..	..	..	..	..
G/29	Somes Island, four paddocks near buildings	..	3·63	8·86	0·242	..	..	0·017	0·010	0·33	0·43	0·41	0·10	..	..	Cl = NaCl, 0·012.
G/30	Somes Island, poor paddock at top of hill	..	4·47	7·65	0·198	..	..	0·030	0·006	0·26	0·46	0·42	0·06	..	..	Cl = NaCl, 0·015.
G/31	Somes Island, virgin paddock on south face	..	3·22	9·24	0·269	..	..	0·020	0·117	0·24	0·32	0·41	0·31	..	..	Cl = NaCl, 0·030.
G/127	Somes Island, extreme north end ..	..	23·50	26·03	0·530	..	..	0·013	0·187	Trace	Trace	0·54	0·84	..	..	Cl -- NaCl, 0·016.
H/99	Mana Island, cliffs, north end ..	..	3·35	7·39	0·266	..	..	0·034	0·007	0·48	0·58	0·53	0·12	..	..	..
H/100	Mana Island, near sea and settlement	..	4·88	11·92	0·392	..	..	0·011	0·165	0·44	0·27	0·22	0·43	..	..	..
G/470	Kapiti Island, north end of spur ..	..	12·07	6·13	0·148	..	..	0·037	0·083	0·54	0·48	0·42	0·17	..	..	..
G/471	Kapiti Island, Webber's paddock ..	..	7·19	6·63	0·124	..	..	0·021	0·024	0·93	0·37	0·24	0·09	..	..	..
G/472	Kapiti Island, Rangitira Point, swamp clay	..	18·02	14·91	0·551	..	..	0·040	0·027	0·87	0·64	0·65	0·17	..	..	..
G/473	Kapiti Island, Rangitira Point, sandy soil	..	10·06	4·63	0·159	..	..	0·021	0·053	1·03	0·26	0·32	0·12	..	..	..
G/474	Tokomapuna Island	..	18·53	25·36	1·041	..	..	0·056	0·439	1·67	0·66	0·57	0·66	..	..	..
G/476	Motukarara	..	5·65	3·51	0·139	..	..	0·014	0·081	0·59	0·22	0·10	0·14	..	..	..
G/477	Tahoramaurea Island, or Brown's Island	..	18·08	12·36	0·436	..	..	0·047	0·346	0·31	0·22	0·41	0·62	..		..
J/21	Bluff, Southland	..	4·16	13·87	0·431	..	..	0·010	0·045	..	..	..	..	..	..	..
J/23	Brighton Bluff, Otago	..	8·16	21·78	0·793	..	..	0·030	0·026	..	..	..	..	..	..	..
E/976–1	Rangitikei dunes, Wellington ..	..	0·08	0·35	..	..	..	0·014	0·031	1·58	0·54	0·15	0·06	..	..	..
–2	Rangitikei dunes, Wellington ..	..	0·14	0·44	..	..	..	0·012	0·031	1·52	0·49	0·19	0·06	..	..	..
E/1027	Sand from Waikato Heads ..	..	0·20	0·33	..	..	..	0·013	0·012	1·99	0·74	0·09	0·05	..	..	..

acid content, and this is where the greatest effect from salt would be felt. In the subsoils there is strong evidence of an iron pan forming in the case of K/3028 and K/3030. In K/3032 the subsoil was deeper, and the sampler did not apparently reach the area of deposition.

That salt is a great solvent of rock material is indicated by the following analyses, showing the original rock and the redeposited wall of an example of honeycomb weathering in greywacke from Fitzroy Bay, Wellington :—

——	Deposited Portion. Per Cent.	Unweathered Rock. Per Cent.
Silica	69·10	74·01
Alumina	11·98	13·95
Ferric oxide	9·57	3·70
Lime	0·80	0·20
Magnesia	0·46	..
Soda	2·90	2·85
Potash	2·00	1·71
Loss on ignition	2·70	3·10

The high phosphate and calcium content of most maritime soils in New Zealand may be safely attributed to the remains of pre-existent life, but the high potash content is probably due to the action of sea-water in depositing potash salts, also in liberating potash from the inert soil silicates, the sodium salts being more largely lost by leaching than the potash salts.

All the islands near Wellington show high phosphate content where soil-samples are taken in places favourable to the congregation of bird, animal, or human life in the past. Where taken in situations unfavourable, as on the top of high flat islands, the figures are normal, except for magnesia and potash, which are contributed from the sea. This applies, for example, to high pasture land on Mana Island. The shrubbery on a small island off Kapiti is tenanted nightly by thousands of starlings, showing that enrichment by phosphates is still proceeding, as demonstrated by inspection and analysis of the roosting-grounds.

Chemical Characters of Some Littoral Soils.

In connection with recent schemes to reclaim estuarial waste lands, three areas have been examined and a series of the soils analysed from widely separated localities, Lake Ellesmere in Canterbury, Blueskin Bay in Otago, and the Napier lagoon and lands elevated by the 1931 earthquake. All three series show the chemical characters claimed for sea littoral soils at their best—the high amount of mineral plant-food in available condition, particularly phosphoric acid and potash, with the lime and magnesia also present in large amounts. The available phosphoric acid is always very high compared with the total amount present, as it generally is in maritime soils.

Other analyses of similar soils where the action of sea salt has evidently greatly influenced the composition of the soil are those collected by the writer around the coasts of Otago and Southland. The Bluff coastal soils show remarkably high available phosphoric acid and potash,

but the hill soils give normal amounts. The analyses of fiord and island soils of south-west Otago are the first to be published. The fiord soils were necessarily taken in situations which were available—that is, on the few flats occurring in this precipitous region, where the mountains rise quickly from sea-level up to a height of 7,000 ft. Naturally the animal life of this extensive area has concentrated on these flats and areas of deep soil, resulting in comparatively high available phosphate content. In a few places the presence of magnesian rocks is indicated by the high magnesian content of the soil, even when taken in the forest as at Anita Bay. Milford Sound also shows high available and total magnesia.

Cone Island, one of the Open Bay islands, covered with primitive vegetation of *Muehlenbeckia complexa*, shows high total and available phosphate. The rock of this island is a limestone. The relatively high total and available magnesia content of the soil may be derived from the sea spray. The rich nature of the soil is indicated by the dense growth of pohuehue. These islands must be deluged with sea spray in westerly gales.

The island soils on the eastern side of New Zealand that have been examined show great paucity of phosphates, possibly due to excessive leaching by salt water and deficiency of life to keep up the supply. The Chatham Islands are very peaty, which renders comparisons difficult, and dolomite occurs there, which may account for the high magnesia content of the soils. On Great Mercury Island the excess of magnesia would seem to be derived from the sea salt, and this would support the idea that there has been great leaching of phosphate from this soil where the pasture is extremely poor and the stock suffer from a malnutrition.

(To be continued.)

INSPECTION OF TOWN-SUPPLY DAIRIES.

DEALING with this subject, the 1931–32 annual report of the Director of the Live-stock Division states: "There are now about five thousand dairies registered for supplying milk to our cities, boroughs, and towns throughout the Dominion, and of these 2,189 supply the four largest centres. During the year all these dairies were kept under close supervision, and where any sign of laxity was observed special attention was paid. The sediment tester has again proved its usefulness. In all districts a large number of milk-samples have been subjected to this test, and where it is found that the milk does not come up to standard the premises are visited and instruction given which brings about an improved condition of the article supplied. A considerable number of composite samples of milk were collected from all districts and sent to the Wallaceville Laboratory for the biological test, and it is satisfactory to report that negative results were obtained, with one exception. This sample came from a herd the milk of which was not being used for city supply. The herd has since been subjected to the tuberculin test and all reacting cows have been eliminated. It is worthy of note that year by year dairymen are becoming more desirous of supplying a better article, and just lately we have had a number of inquiries with regard to supplying milk from certified herds free from tuberculosis. Rules have been drawn up so that dairymen may be able to sell milk under these conditions."

COMMERCIAL FERTILIZERS AND THEIR BASIS OF SALE.

VI. POTASH SALTS.

J. A. Bruce, Inspector of Fertilizers, Department of Agriculture, Wellington.

The principal sources of potash are the various water-soluble salines obtained from underground mineral deposits of crude potash. The most notable mines occur in Germany, where an industry of great magnitude, comparable with that of the famous nitrate industry of Chile, has long been established. More recently discovered potash beds of similar character to those of Germany occur in France (Alsace), Spain, Poland, and United States (New Mexico). Russia has easily the largest known resources of potash, but so far they have not been exploited to any great extent.

The generally accepted opinion of geological authorities concerning the formation of the German and French potash beds is that they are the residues of dried up inland seas like the Dead Sea of Palestine. The same opinion would also appear to be held in reference to the other deposits cited. In the deposits of Germany many different types of crude salts and saline minerals of varying composition occur in roughly-defined layers of great thickness. In such layers rock salt, and the potash-bearing compounds carnallite (9 to 17 per cent. potash), kainit (12 to 16 per cent. potash) and sylvinite and hardsalt (16 to 17 per cent. potash) are found in association with salts of magnesia, lime, and other saline materials.

The Potash Industry of Germany.

Potash deposits which have proved of great value to agriculture throughout the world were discovered in the year 1857 while borings were being made for rock salt at Stassfurt near the Harz Mountains. However, the importance of this discovery was not realized until 1860, and the first factory for refining crude potash salts followed in 1861. Further discoveries of extensive deposits were subsequently made, and within recent years mines have been worked in the districts of Hanover, Stassfurt, South Harz, Werra, Mansfeld, Halle, and Unstrut. Taking the districts together, the deposits are so large—estimated at approximately 14,000,000,000 cubic yards—that the whole world could probably be supplied for a thousand years or more at normal rates of production. As affording some idea of the enormous scope of the industry, it may be mentioned that in the year 1922, 55,000 hands were employed, notwithstanding the fact that of a total of 214 shafts only 128 were in operation, while eighty-six were idle. Seventy-six chemical works were engaged in refining the crude salts from these mines, the production of which alone amounted to over 11,000,000 tons. Operations to-day have necessarily been considerably restricted, as like many other industries the potash industry has suffered severely from the economic depression.

The potash-producers of Germany are organized into a powerful sales organization or syndicate (Kalisyndicat) with headquarters at Berlin.

This group has enormous investments of capital in the mines and refineries, as well as possessing very efficiently-run propaganda and technical advisory services. Until the outbreak of war in 1914 the Potash Syndicate had, practically speaking, the exclusive control of the sale of potash salts throughout the world. The very serious consequences of agricultural potash shortage had to be faced by many belligerents as a result of the complete shutting-off of German potash supplies.

The Industry in France.

Rich deposits, consisting chiefly of the potash-bearing (saline) material sylvinite, situated in the Haut-Rhin district near the Vosges Mountains in Alsace, are estimated to contain about 300,000,000 tons of chloride of potash. Discovered in 1904, and worked to a limited extent by Germany for several years before the Great War, these deposits became the property of France at the cessation of hostilities in 1918.

Like the German industry, which is controlled officially by a federal council, the French Government exercises some control over the industry in Alsace. A sales agency, however, the Société Commerciale des Potasses d'Alsace, formed in 1919, is responsible for the marketing of the mine products, consisting for the greater part of chloride of potash.

Close co-operation with German producers has been maintained by the French potash-producers in recent years as far as grades marketed and prices, &c., are concerned. Owing to the scarcity of sulphate of potash in the deposits the chemical conversion of muriate of potash into sulphate of potash is not undertaken to any great extent in Alsace by reason of the fairly high production costs entailed. In 1922 seventeen shafts were reported to be working, and in 1924 the production of crude salts from the mines was in excess of 1,000,000 tons.

Potash in Poland.

Deposits of kainit and sylvinite with some carnallite occur near the salt mines of Carpathia, in Galicia, in the Kalusz, Stebnik, Drohhoycz, and Stanislawow districts. The Stebnik kainit, sold in three grades, contains about 9 or 10 per cent. of actual potash present in both sulphate and chloride form. The kainit from the Kalusz Mine is sold in several grades varying in actual potash content from 12 to 17 per cent. The Polish potash manure salts contain 20 to 22 and 30 to 32 per cent. actual potash respectively. Production of crude salts was about 80,000 tons in 1924.

Potash Importations into New Zealand.

Practically all potassic salts absorbed by agriculture in New Zealand are brought from Germany and France, with the exception of a few small shipments of kainit and 30-per-cent. grade salt which have arrived here recently from Poland and Belgium. The little that has come from Belgium is apparently mined elsewhere in Europe, as no known Belgian deposits are exploited.

Importation statistics covering the past twenty years indicate that, while our consumption has been and still is very small when compared with our high consumption of phosphates, the use of potash has more than doubled during the last eight years (April, 1924 – March, 1932).

when compared with the preceding eight *normal* years (April, 1911 – March, 1915, and April, 1920 – March, 1924). The period affected by the Great War is not taken into account, as only some 225 tons of potash fertilizers were imported during those abnormal years. Until 1925 kainit was the principal form of potash carrier imported, but since that year it has steadily given place to the higher grade 30-per-cent. potash salt of over double the fertilizing strength. Taken together, kainit and potash manure salt (chiefly 30-per-cent. K_2O grade) represent roughly 80 per cent. of the total potash fertilizer imports of nearly 95,000 tons for the past twenty-year period ended in March of this year. Muriate and sulphate of potash (mainly the sulphate), the importations of which have remained proportionately steady throughout, account for the remaining 20 per cent. During the past three years ending 31st March in each case the import figures for all forms of potash are: 1929–30, 8,190 tons; 1930–31, 8,190 tons; 1931–32, 4,628 tons.

Some Points regarding the various Grades and Forms of Potash.

The following types of potash salts are marketed in this Dominion:—

(1) Potash manure salt ..	30 per cent. "actual potash" as chloride.
(2) Sulphate of potash ..	48 per cent. "actual potash" as sulphate.
(3) Kainit	14 per cent. "actual potash" as chloride.
(4) Muriate or chloride of potash	50 per cent. "actual potash" as chloride.
(5) Potash manure salt ..	20 per cent. "actual potash" as chloride.

The finely crystalline potash salts on the market from Germany somewhat resemble common salt in appearance, although the colour of different shipments, more particularly those from France, varies owing to the presence of traces of harmless impurities such as iron, clay, and organic matter. In some cases the crude or lower-grade potash carriers, such as kainit, are put on to the market direct without any special treatment other than perhaps grinding; but, as a rule, they are partially refined as far as economically possible, so as to avoid the cost of transport and handling of less desirable or unwanted material with which the potash is associated in the mines.

Potash fertilizer salts are sold under a wider range of qualities overseas, but only those that are used in New Zealand will be referred to. The principal potash-bearing crude salt is carnallite, which contains only 9 to 17 per cent. of actual potash (K_2O). After being taken out from the mines this is purified by a process of recrystallization to obtain muriate of potash; and the potash salt known to us in 20 and 30 per cent. grades may be obtained as a by-product, although it also occurs naturally to some extent. Sulphate of potash is made from the muriate by treatment with kieserite (sulphate of magnesia) or with sulphuric acid. Kainit and hardsalt (sylvinite) are the crude salts as mined.

POTASH MANURE SALT, 30 PER CENT. and 20 PER CENT.

The 30-per-cent. grade salt, being cheaper per unit of potash than other forms of potash on the market with the exception of the muriate (50-per-cent. grade), is the main type of potash fertilizer employed in this country. The name "potash manure salt" is unfortunately not an appropriate one for distinguishing this salt from the various other

potash fertilizers, such as muriate and sulphate of potash, which are also designated chemically as potash salts or potash manure salts.

It has already been stated that both grades are either partially refined crude salts from the mines or are a by-product in the manufacture of the muriate of potash. Besides containing chloride of potash they carry impurities in the form of common salt and small proportions of sulphate or chloride of magnesia and calcium salts. (See Table 4 for detailed percentage composition.)

Since the 30-per-cent. salt has 30 per cent. of plant-food or actual potash (K_2O) in its composition, it cannot be termed a low-grade fertilizer; on the other hand, it is not nearly so concentrated as the sulphate and muriate of potash, both of which have somewhere about 48 to 50 per cent. of actual potash in their composition. Very little, if any, of the 20-per-cent. salt now appears to be sold in the Dominion, but the principal use of the 30-per-cent. quality is for pasture top-dressing, while the great majority of proprietary mixed fertilizers for special crops also contain minor proportions of this 30-per-cent. salt.

SULPHATE OF POTASH.

As a fertilizer sulphate of potash is customarily sold on a basis of 48 or 48·6 per cent. of actual potash (K_2O), equivalent to about 90 per cent. sulphate of potash, thus showing a fairly high degree of purity. Its high plant-food content entitles it to be rated as a concentrated fertilizer, practically on a par with urea (46 per cent. of nitrogen).

Sulphate of potash occurs naturally to a minor extent in the French and German deposits, but in practice it is made (chiefly in Germany) by treating the muriate with sulphate of magnesia or with sulphuric acid. It is marketed in good mechanical condition as a light-grey or faint-pink salt, at a somewhat higher price than the muriate owing to the greater cost of production. Preference is given to it for potato, tobacco, and some market-garden crops in which there is any risk of quality being adversely affected by dressings of the chloride forms of potash. Certain limited amounts are used in the preparation of proprietary mixed fertilizers, but not to the same degree as is the 30-per-cent. grade potash manure salt.

MURIATE OR CHLORIDE OF POTASH.

This is the potash equivalent of common salt (chloride of sodium) and has a similar taste. It is manufactured by dissolving the ground crude salt (carnallite) in vats of boiling magnesium chloride, which is then concentrated and allowed to stand for several days to crystallize.

Although available in more than one grade on British and Continental markets, the commercial chloride, or muriate as it is more popularly termed, is customarily sold here on a basis of 50 per cent. actual potash (K_2O). Although having a high concentration of potash (K_2O) it is not quite so pure (purity 80 per cent. chloride of potash) as the sulphate, but actually it contains slightly more potash (K_2O), and is much cheaper per unit than the sulphate. Its impurities consist largely of common salt present to the extent of 14 or 15 per cent. Sulphate of potash is from 90 to 95 per cent. pure,

being almost free from impurities such as common salt. The local small importations of muriate mostly go to fruitgrowers. Muriate is suitable for the majority of crops requiring potash with the exception of potatoes, tobacco, and one or two others for which the sulphate or carbonate form of potash is preferred. Considerable savings in transport and haulage can be effected by its use, as it is at present cheaper per unit of potash than other forms of potash offered.

KAINIT.

Kainit is technically a mineral compound of chloride (muriate) of potash and sulphate of magnesia. As found in nature the commercial product marketed as fertilizer varies widely in composition according to the mine from which it is derived—that is to say, German, French, or Polish, &c. It occurs in irregular deposits, occasionally as a white but more often as a reddish salt. It contains a considerable amount of rock salt (sodium chloride). (See Table 4 for composition.) The kainit now on the overseas markets differs from what was originally sold as kainit. The modern product is stated to be a mixture of carnallite, sylvinite, and/or hardsalt ground with rock salt, the content of actual potash varying from about 12 to 16 per cent.

On the Continent of Europe kainit, by reason of its high percentage of common salt, is employed for killing weeds, such as charlock, in cereal crops. Kainit is well recognized by farmers in New Zealand as being specially suited for crops requiring a certain amount of common salt, such as mangels, &c.; nevertheless it is the most expensive of all the potash fertilizers per unit of potash, and seeing that the 30-per-cent. salt is much cheaper and contains a sufficiency of common salt, a saving could be effected by always using the latter in place of 12 to 14 per cent. kainit, which, after all, is nothing more than a low-grade potash salt for which a comparatively high price is paid.

CONFUSION IN USE OF WORD "POTASH."

Confusion almost invariably arises out of the use of the word "potash." The average purchaser does not make any distinction between the various qualities of potash—whether they are in the form of sulphate of potash, or muriate of potash, or 20-per-cent. or 30-per-cent. potash manure salts. It is only natural to expect that he is somewhat perplexed when it is found from the invoice certificate he receives that sulphate of potash, for instance, described in the price-list or quoted by a salesman as a 90-per-cent. grade, contains actually only 48 per cent. of potash.

The correct way to describe the quality of a potash fertilizer is to state the percentage of dipotassic oxide or K_2O and the form in which it occurs—as sulphate or as chloride. Although only a hypothetical compound so far as fertilizers are concerned, oxide of potassium has been universally adopted as the standard method of description of the essential potash plant-food contained in any fertilizer. Therefore every potash salt, whether it be of a purity of 90 per cent., 80 per cent., or even 100 per cent., must have its potash content stated in statutory statements in terms of the oxide of potassium (K_2O), or "actual potash" as it is frequently termed. This "actual potash" content, which is in the first place determined or checked by a chemist or analyst, should be the guiding factor as regards quality. Purity figures can be ascertained by a simple arithmetical conversion of "actual potash" to sulphate or muriate of potash as the case may be. Similarly, if

the quality of a potash fertilizer or of a mixed fertilizer containing some potash is expressed in an advertised statement in terms of either sulphate or muriate of potash equivalency instead of in "actual potash" (K_2O) a simple conversion may be made. The following table will be found helpful in cases of this sort :—

Table 1.—Equivalents of Potash (K_2O) in Terms of Sulphate of Potash and Muriate (Chloride) of Potash.

Potash (K_2O).	Sulphate of Potash.	Chloride of Potash.	Potash (K_2O).	Sulphate of Potash.	Chloride of Potash.	Potash (K_2O).	Sulphate of Potash.	Chloride of Potash.	Potash (K_2O).	Sulphate of Potash.	Chloride of Potash.
Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	1.85	1.58	6	11.1	9.5	12	22.2	19.0	30	55.5	47.5
2	3.7	3.2	7	12.9	11.0	14	25.9	22.2	48	88.8	76.0
3	5.5	4.7	8	14.8	12.7	20	37.0	31.7	49	90.6	77.6
4	7.4	6.3	9	16.6	14.2	21	38.8	33.2	50	92.5	79.1
5	9.2	7.9	10	18.5	15.8	22	40.7	34.8	51	94.3	80.7

NOTE.—To convert potash (K_2O) into its equivalent of sulphate of potash multiply by 1·850 ; conversely, sulphate of potash in terms of potash (K_2O) may be ascertained by dividing by 1·850.

To convert potash (K_2O) into its equivalent of chloride of potash, multiply by 1·583 ; conversely, chloride of potash in terms of potash (K_2O) may be found by dividing by 1·583.

VALUATION OF POTASH FERTILIZERS.

In comparing potash fertilizers "unit values" are often a useful basis for arriving at a decision of what is the best value. If, for example, a potash salt priced at £9 17s. 6d. per ton is guaranteed to contain 30 per cent. of "actual potash" (K_2O) soluble in water, it contains 30 units of potash which together cost £9 17s. 6d. The cost of each unit is therefore £9 17s. 6d.÷30=6s. 7d. On the other hand, if a potash salt—*e.g.*, muriate—containing 50 per cent. (or units) of actual potash is quoted at 6s. 7d. per unit, the cost per ton is 50×6s. 7d.=£16 9s. 2d. (approximately £16 10s.). If then the latter is quoted or calculated at less than 6s. 7d. per unit it is cheaper than the former on its actual plant-food content.

A comparison of potash unit values indicative of the price trend over a period of years is afforded from the table following. It will be noted that the 30-per-cent. potash salt and muriate of potash are now tending toward their pre-war price-level notwithstanding the exchange rate premium.

Table 2.—Potash Unit Values, 1909, 1918, 1924, 1932.

Designation (and Potash Content per Cent.).	Unit Values.* 1909.	1918.	1924.	1932.
	s. d.	s. d.	s. d.	s. d.
Sulphate of potash (48) ..	6 0	22 6	8 4	8 1
Muriate of potash (50)	6 0	..	7 0	6 0†
30-per-cent. potash salts (30) ..	6 0	..	7 0	6 7
20-per-cent. potash salts (20) ..	..	..	8 6	..
Kainit (14)	7 6	24 0	10 0	10 6

* Based on recent net prices at Auckland and New Plymouth, except where otherwise stated.
† Free on rail, Auckland.

Fertilizing Value.—The relative quantities of each fertilizer required for per-acre applications in the field is also dependent chiefly on the percentage of actual potash (K_2O) each contains, except where one particular form (that is, chloride or sulphate) is desired for special cropping conditions. By reading the following columns downwards the amount in pounds of any one fertilizer equal to 1 cwt. (112 lb.) of any other potash fertilizer can be seen. For practical purposes sulphate and muriate of potash may be regarded as containing almost the same amount of potash (K_2O).

Table 3.—Fertilizing Value Equivalents.

Fertilizer and Percentage of Potash.	Kainit (14).	Potash Salts (20).	Potash Salts (30).	Muriate and Sulphate of Potash (say, 50).
	lb.	lb.	lb	lb
Kainit (14)	112	160	240	400
Potash salts (20)	78	112	168	280
Potash salts (30)	52	75	112	187
Muriate and sulphate of potash (say, 50)	32	45	67	112

To handle 1 ton of muriate (chloride) of potash distributed over, say, 10 acres at 2 cwt. per acre, would cost about the same as the handling of 1 ton of kainit, which, at the same rate of actual potash application, would cover only 3 acres.

Composition of Potash Salts.

Some knowledge of the composition of potash fertilizer salts is always of use to those handling fertilizers. In certain grades there is a proportion of common salt and other substances present which, although classified as impurities of no fertilizing value, may be of special benefit, of no use, or even detrimental to the quality or growth of particular crops. This applies more particularly in the case of the constituent common salt. About 50 to 60 per cent. of common salt is contained in 14-per-cent. kainit ; in 20-per-cent. potash salt 40 to 50 per cent. ; in 30-per-cent. potash salt 20 to 30 per cent. ; and in muriate of potash 15 per cent. or less. (Table 4 gives the average detailed composition of potash salts consumed in New Zealand.)

Table 4.—Average Composition of Potash Salts.

Designation.	Sulphate of Potash.	Chloride of Potash.	Sulphate of Magnesia.	Chloride of Magnesia.	Chloride of Soda (Common Salt).	Sulphate of Lime (Gypsum).	Matter insoluble in Water.	Water.	Guaranteed Minimum of Pure Potash (K_2O).
Sulphate of potash	90·6	1·6	2·7	1·0	1·2	0·4	0·3	2·2	48·6
Muriate (chloride of potash)	..	83·5	0·4	0·3	14·5	..	0·2	1·1	50·4
30-per-cent. potash manure salt	..	48·6	10·2	4·2	26·2	2·2	3·5	5·1	30·0
20-per-cent. potash manure salt	..	33·3	12·0	4·2	40·2	2·1	4·0	4·2	20·0
Kainit (14 per cent.)	..	23·7	..	0·1	62·3	2·5	10·2	1·1	14·0

Sir E. J. Russell, in his bulletin, "Artificial Fertilizers in Modern Agriculture," written for the English Ministry of Agriculture, points out that if the various potash salts differed merely in their content of potassium the choosing between them would be relatively simple. The matter, however, he states, is more complicated; the sodium, magnesium, chloride, and probably sulphate ions all have specific actions on the crop, in addition to those provided by the potassium. In discussing each element separately, attention is drawn, *inter alia*, to the following points regarding each element :—

Sodium: The effect of sodium is twofold; it acts on the soil, making the reserves of potassium more easily available to the crop, and it enables the plant in some way to make better use of a limited ration of potassium. It is an economical fertilizer for mangels and hay; on the other hand, it may damage the quality of potatoes, and hence should not be used for them.

Magnesium: This is an essential constituent of chlorophyll, the green colouring matter of the plant; any deficiency shows itself in a yellowing or "chlorosis" of the leaf, or in premature loss of the leaf. The best known instance is the disease termed "sand drown," a chlorosis affecting tobacco in South California.

Chloride ion: Though not essential to plants, the chloride ion in small amounts appears to be beneficial. Mangels and barley benefit by the use of chloride as a fertilizer, but potatoes do not benefit. In large quantities the chloride ion is harmful to all crops, particularly potatoes, while mangels are more tolerant.

Sulphate: Sulphur is an essential constituent of plants and occurs in some quantity in cabbages, swedes, turnips, and other members of the Brassica family, and it has been shown that sulphates increase the yield of heavy-yielding crops rich in protein. Sulphur appears to be particularly advantageous in dry seasons.

THE AMOUNT OF POTASH IN PROPRIETARY MIXED FERTILIZERS, ETC.

The average plant-food content of the unusually large number of New Zealand proprietary factory-mixed fertilizer mixtures carrying the

Table 5.

Fertilizer Designation.	Nitrogen (N) soluble in Water—Per Cent.	Phosphoric Acid (P_2O_5)—Per Cent.	Potash (K_2O) soluble in Water—Per Cent.
Containing Two Plant-foods.			
Potassic superphosphate (local manufacture)	..	16·5*	3·0 (chloride).
	..	19·0*	2·3 (sulphate).
Potassic basic super (local manufacture)	..	17·2†	2·2 (chloride).
Potassic "Phosfull"	..	23·0†	5·0 (chloride).
Potassic "Gafsa"	..	18·0†	8·0 (chloride).
Potassic phosphate (local manufacture)	..	27·5†	5·0 (chloride).
Containing Three Plant-foods.			
Nitrophoska	16·5	16·5*	20·0 (chloride).
Peruvian guano (and potash) ..	5·7†	11·4†	6·0 (sulphate).
Dissolved Peruvian guano	4·5†	9·0‡	1·5 (sulphate).
Nitro-potassic phosphate	3·5†	15·0†	4·5 (chloride).

* Soluble in water. † Insoluble in water. ‡ 6 per cent. soluble, 3 per cent. insoluble in water.

three essential plant-foods is as follows: Nitrogen, 1·3 per cent.; phosphoric acid, 18·5 per cent.; and potash (K_2O), 2 per cent., present principally as potash 30-per-cent. (chloride) salt. The amount of potash may vary, however, from 0·4 per cent. to 7·5 per cent., according to the different manufacturing sources. A dressing of a mixture containing 0·4 per cent. of potash at the rate of 2 cwt. per acre would mean that the crop would receive under 1 lb. of actual potash (K_2O) to the acre. It seems scarcely necessary to emphasize the futility of putting such a small amount of potash in any mixture.

A number of imported and locally manufactured fertilizer mixtures containing two plant-foods and other imported preparations are listed in Table 5 in order to show their potash content in comparison with nitrogen and phosphoric acid.

NOTE.—The attention of those interested is drawn to the following articles in this *Journal*: "Potash and the Great War: Money in Ashes" (B. C. Aston), Vol. 11, p. 18); "Potash in Agriculture (B. C. Aston), Vols. 11, p. 283; 13, p. 446; 14, p. 440; and 16, p. 249); "Potash in New Zealand and other Countries" (P. G. Morgan), Vol. 14, p 257.

(Series to be continued.)

THE TOMATO STEM BORER (*GNORIMOSCHEMA PLAESIOSEMA* TURNER).

J. MUGGERIDGE, Entomologist, Plant Research Station, Palmerston North.

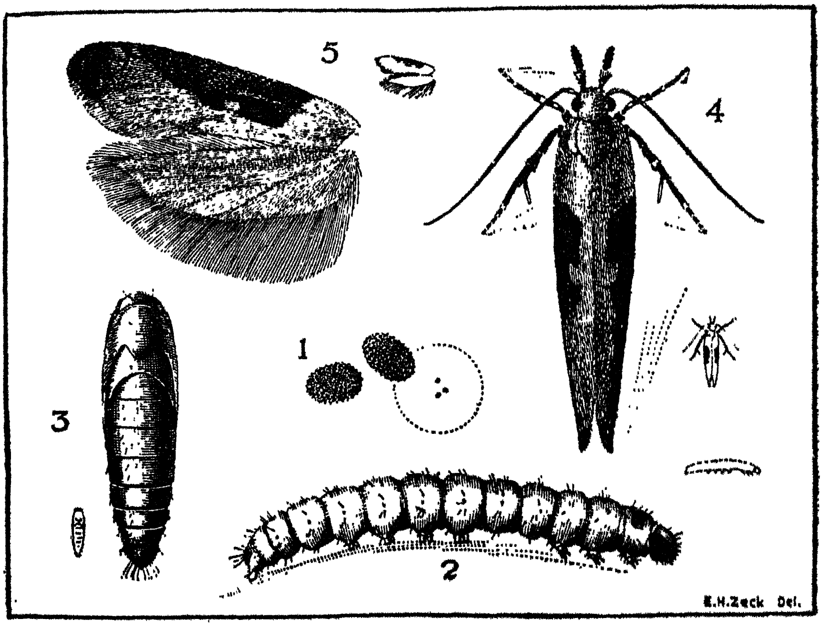
THE purpose of this article is to put on record a history of the tomato stem borer in New Zealand, supplemented with notes from the literature on its life history and control.

During the 1930–31 season there was considerable concern among tomato-growers on account of a new pest which was responsible for the destruction of thousands of tomato plants in different parts of the country. From an examination of infested material the injury was found to be due to a small slightly pinkish-tinged moth larva (Fig. 2) measuring approximately $\frac{7}{16}$ in. in length. Plants suffering from attack gradually wilted and died. On examination, the stems of the wilted and dead plants were found to be severely tunnelled by the small caterpillars referred to.

Specimens of the insects were reared to the adult stage and were identified by the late Mr. Philpott of the Auckland Museum as *Phthorimaea melanoplintha* Meyr., a supposedly native species first described by Meyrick in 1926. The writer also sent specimens to the Bureau of Entomology at Washington, U.S.A., where they were examined by Dr. August Busck. Dr. Busck (1931) reported that these specimens were identical with his *Gnorimoschema (Phthorimaea) tuberosella* Busck, described from Peru, where it is a pest of potatoes. He stated that the species is a native of the west coast of the Americas, and has been received from California reared both from stalks of potato and from its original food plant, *Solanum nigrum* (deadly nightshade). Again, Morgan (1931) refers to the tomato stem caterpillar in New South Wales as a new species described by Turner (1919) as *Phthorimaea plaesiosema*. Dr. Busck has now examined the Australian species and finds it is identical

with *Gnorimoschema melanoplintha* Meyr.* The insect should therefore be known as *Gnorimoschema plaesiosema* Turner.

G. plaesiosema has been present in New Zealand for a number of years and was reared from tomato stems by J. G. Myers in January, 1924. It was only in 1929–30, however, that it began to attract attention here, and in 1930–31 it was a serious pest as already stated. Since this time little has been heard of it, and it is quite likely that the spray treatment recommended in this *Journal* for March, 1931, page 175, has largely contributed to its apparent check or control.



(1) Eggs; (2) larva; (3) pupa; (4) adult moth; (5) fore and hind wings.

[*After Morgan.*

LIFE HISTORY.

In the absence of life-history studies of the pest in New Zealand, the following information from an article by Morgan (see Bibliography) should form a suitable basis for detailed studies when undertaken.

The eggs (Fig. 1) are laid singly on tomato foliage, or in the "eyes" or in the cracks or scars of potato tubers, about three hundred eggs being laid by a single female. The eggs hatch in from seven to eleven days.

The young caterpillars (Fig. 2) may feed upon the leaf surface before commencing to mine into the leaf tissue. From the leaves they make their way into the leaf stalk and work down into the tomato stems,

* For a discussion of the genus see Busck (loc. cit.).

which may be so severely bored as to check the flow of sap and consequently destroy the plant. The length of the larval stage is apparently governed largely by climatic factors, since it may take only three weeks to complete in this stage in the summer but may take up to six weeks in the winter.

The pupae (Fig. 3), which were commonly found in injured tomato stems, are small brownish objects about ¼ in. in length. This stage occupies ten to fourteen days.

The adult insect (Fig. 4) is a small greyish-brown moth with a wing expanse of about ⅝ in. The forewings (Fig. 5) are narrow, with characteristic dark brown patches near the centre. The hind wings are much paler in colour.

CONTROL.

A good and constant cover of lead arsenate spray (1½ lb. powder per 100 gallons of water) thoroughly applied to the whole plant appears to give effective control. Morgan recommended lead arsenate spray applied at a strength of 1½ lb. of the powder to 20 gallons water, or a 50 per cent. lead arsenate dust applied at weekly intervals. All dead tomato plants and such debris should be heaped up and burned. Deadly nightshade (*Solanum nigrum*) should be destroyed likewise. Owing to the fact that the moth readily attacks potatoes, both stalks and tubers, it should be remembered that a potato crop in the vicinity of tomato plants may serve as a source of infestation to the latter.

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Compensation paid for Stock and Meat condemned.—Compensation to the amount of £13,163 16s. was paid out during the year ended 31st March last for animals condemned in the field for disease under the provisions of the Stock Act, and £10,806 9s. 4d. for carcasses, or parts of carcasses, condemned for disease on examination at the time of slaughter at abattoirs, meat-export slaughterhouses, &c., under the provisions of the Slaughtering and Inspection Act.

Sodium Chlorate for Weed Control.—The annual report of the Live-stock Division for 1931–32 remarks: "During the year sodium chlorate applied by spray has again proved an effective agent in the eradication of ragwort and other soft-leaf weeds. In some localities a measure of success has been obtained with this spray on blackberry, the plants having been sprayed from two to four times with very fair results. In other cases settlers have sprayed once only, at flowering time, to destroy the fruit, this method being quicker than cutting and entailing considerably less labour. So far as mature gorse is concerned, the results of spraying with sodium chlorate have been disappointing, while with broom and lupin the results have been encouraging.

PULPY KIDNEY DISEASE OF LAMBS.

INVESTIGATIONAL WORK IN 1932 SEASON.

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IN the last article regarding pulpy kidney disease of lambs published in this *Journal*(1) the writer stated the then position so far as research work on the disease in this country was concerned, and mentioned the results obtained by Montgomerie(2), Bennetts(3), and Oxer(4) in their work on identical or very closely allied diseases of sheep and lambs in their respective countries.

It may tend to greater clarity to recapitulate slightly in the first place. In 1930 the writer(5) discovered that a highly potent toxin was present in the small-gut contents of affected lambs, which would set up a condition indistinguishable from pulpy kidney if it was injected into the blood of a normal, healthy lamb. In normal lambs no such toxin was present. There was good reason to suppose that it had been formed in the affected lamb's gut by a microbe.

NOTE.—As the rather frequent use of the terms "toxin" and "antitoxin" is unavoidable, it seems best to digress for a moment in order to make it clear to uninitiated readers what these terms mean. A toxin, for the purposes of this article, simply means a poisonous substance produced by a microbe during its growth. A microbe which has the power to produce a toxin when growing in the tissues or the intestine of an animal can usually be made to produce it also when it is grown artificially in a laboratory, provided it is given the right conditions and food (medium). Different microbes produce different toxins. It is important to note this fact, because it gives the most reliable means we have of telling whether two toxin-producing microbes are of the same species or not. This brings one to the subject of antitoxins. If the toxin produced by a given microbe is inoculated into an animal at intervals, in doses too small to kill it, the animal reacts by forming in its blood and tissues a substance which has the power to neutralize or render harmless the particular toxin that has been injected. This neutralizing substance is called an antitoxin, and it is present in the blood serum of the inoculated animal. It will only neutralize the same sort of toxin as that which was injected, though in some cases it will also have a weak neutralizing effect on toxins produced by microbes of the same group. Thus, if an unknown microbe is found to be a toxin-producer, one can identify it (provided it is not an entirely new variety) by finding out what sort of antitoxin will neutralize its toxin.

Montgomerie(2) confirmed the presence of a powerful toxin in the gut of affected lambs in North Wales. In 1931 the writer isolated several strains of a particular organism from affected lambs in the Oamaru district. There was reason to suppose that this organism was the source of the toxin. At about this time Bennetts(3) published an account of infectious entero-toxæmia of sheep in Western Australia, and a comparison of the organism found by him to be the cause of that disease (*Bacillus ovitoxicus*) with the strains obtained from the Oamaru cases of pulpy kidney suggested that if they were not actually identical they were at any rate very closely allied. (It is a pleasure

to acknowledge at this stage the kindness shown me by Dr. Bennetts in forwarding cultures of *B. ovitoxicus*, together with its toxin and antitoxin, and much helpful information about its cultural peculiarities, &c.) Finally Oxer([4]) published a brief account of his work on pulpy kidney in Tasmania, from which he concluded that the cause was the absorption from the small intestine of *B. ovitoxicus* toxin produced there by the growth of that organism.

When the writer published a statement regarding the results obtained in New Zealand([1]) it was mentioned that the identity of the New Zealand organism must await tests made with standardized toxins and antitoxins. The following will explain briefly the necessity for this. One organism may look like and grow like another, but may nevertheless produce a different toxin. The strains derived from pulpy kidney cases in New Zealand obviously belonged to a group of closely allied species called the *Bacillus welchii* group. Until a few years ago it was thought that there was only one toxin-producing organism of this sort — namely, *B. welchii*. But in 1928 Dalling([6]) described an organism causing lamb dysentery in Britain (L.D. bacillus) which, while it looked like *B. welchii*, produced quite a different toxin. In 1930 McEwen([7]), working in the Romney Marsh district in England, described a third species, *B. paludis*, and Bennetts's *B. ovitoxicus* of Western Australia makes a fourth.

Consequently, although as has been previously mentioned in this *Journal*, the New Zealand organism and *B. ovitoxicus* neutralized each other and agreed also in both neutralizing *B. welchii*, it was necessary to make quite sure that they also agreed in their action regarding the other two members of this group. To enable this part of the work to be done the necessary standardized toxins and antitoxins were very kindly sent out from England by Dr. R. A. O'Brien of the Wellcome Physiological Research Laboratories. The toxins and antitoxins of the New Zealand organisms were then carefully tested with results which are shown in Table 1. (In the column headed "Neutralization" "+" means that neutralization occurred, and "−" means that it did not occur.)

Table 1.—Results of Testing Toxins and Antitoxins of New Zealand Organisms.

Toxin.	Antitoxin.	Neutralization.
N.Z. pulpy kidney ..	*B. welchii*	−
	L.D. bacillus	+
	B. paludis	−
	B. ovitoxicus	+
	N.Z. pulpy kidney organism	+
Antitoxin.	**Toxin.**	**Neutralization.**
N.Z. pulpy kidney ..	*B. welchii*	+
	L.D. bacillus	−
	B. paludis	−
	B. ovitoxicus	+
	N.Z. pulpy kidney strains ..	+

Considerably more work has been carried out than is summarized in this table, but is not recorded here as it would involve a great deal of detail which might be confusing. It is sufficient to say that the results tabulated agree exactly with those obtained by Bennetts(3) for *B. ovitoxicus*.

From a comparison of the other characters of *B. ovitoxicus* and the New Zealand strains—their reaction to different culture media, &c.—there appears to be at least one striking difference. When the two organisms are grown on solidified blood serum the New Zealand strains liquefy it in a few days, whereas *B. ovitoxicus* has no such power. Since this is so, and because it is possible that still other distinct species of the *B. welchii* group may be found which may bring to light toxin-antitoxin differences between New Zealand strains and *B. ovitoxicus* (the discovery of the latter revealed a previously unsuspected difference between L.D. bacillus and *B. paludis*) it seems preferable in the meantime to name the New Zealand strains "*Bacillus ovitoxicus* var. *N.Z.*"

ARTIFICIAL PRODUCTION OF PULPY KIDNEY IN LAMBS.

A small number of very early lambs were used to try the effect of injections of toxins prepared from cultures of the New Zealand strains. Lambs inoculated with this material, either into the blood stream or into the muscles, die in a shorter or longer time (a few minutes to a few hours) depending on the size of the dose injected.

As with lambs which die of this disease under farm conditions, the kidneys are not pulpy at death, but they become so shortly afterwards. The most striking example obtained was one in which the kidney was congested but quite firm and not much altered, even when examined miscroscopically at death, ***but within four and a half hours was completely pulpy.*** Microphotographs of this case and of the kidneys of some natural cases are here reproduced.

GROUNDS FOR CONSIDERING THAT THIS ORGANISM AND ITS TOXIN ARE RESPONSIBLE FOR PULPY KIDNEY DISEASE.

(1) There is a toxin in the small gut of affected lambs which is not present in that of healthy lambs.

(2) If this toxin is inoculated into the blood of healthy lambs they die with symptoms and post-mortem findings that are indistinguishable from a natural case of pulpy kidney.

(3) The toxin in the affected lamb's gut is neutralized if it is mixed with antitoxins prepared from *B. ovitoxicus* (Bennetts), N.Z. pulpy kidney strains, and L.D. bacillus*, but is not neutralized by *B. welchii* or *B. paludis* antitoxin.

* The statement previously made (this *Journal*, April, 1932) that L.D. bacillus antitoxin had not neutralized the toxin in the gut of affected lambs requires explanation. The writer had two different samples of L.D. antitoxin in his possession. It has now been found that whereas one of them (that was used in the experiments previously referred to) was quite unable to neutralize the toxins involved, the other definitely has that power, though not in a very high degree. The reason for this is under consideration at the moment.

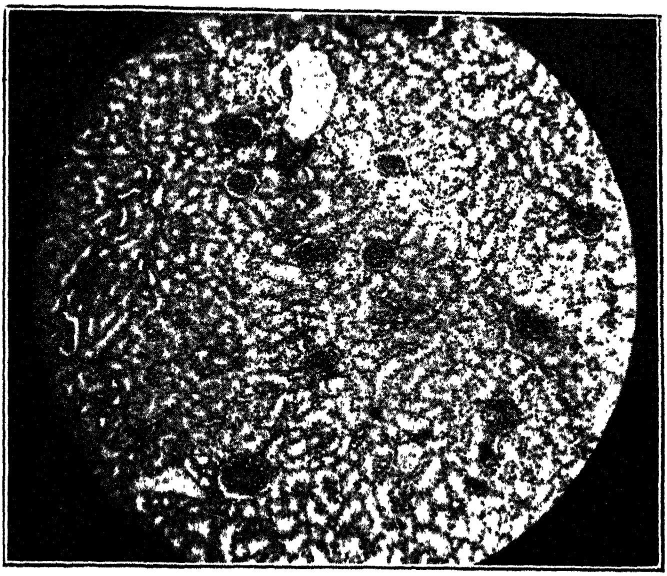

FIG. I. EXPERIMENTAL CASE OF PULPY KIDNEY: MICROPHOTOGRAPH OF KIDNEY SECTION FROM SPECIMEN COLLECTED AT TIME OF DEATH.

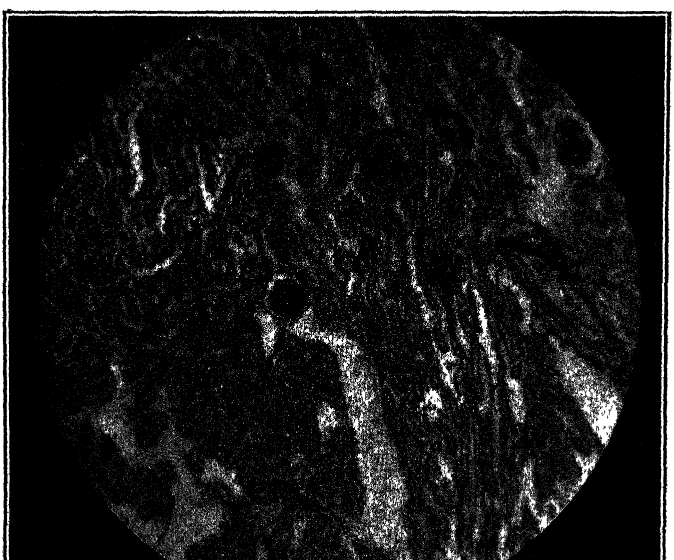

FIG. 2. SAME KIDNEY AS IN FIG. I, FOUR AND A HALF HOURS AFTER DEATH.

(4) If cultures are made in a suitable manner from the lower small intestine of affected lambs an almost pure growth of this organism results.

(5) Under suitable conditions it can be made to yield a highly potent toxin when it is grown in the laboratory.

(6) This toxin, made in the laboratory, agrees exactly in its toxin-antitoxin relationships with that present in an affected lamb's intestine (see No. 3 above).

(7) The artificially made toxin from this organism, when injected into lambs will cause as marked pulpiness of the kidneys as is ever seen in the naturally occurring disease.

Experiments on the Protection of Lambs against Pulpy Kidney Disease by Use of a Vaccine and Antitoxin made from the Organism involved.

Since this disease usually affects lambs in a given district only during a period of three or four weeks, it will be apparent that if one could give lambs a large inoculation of antitoxin prepared from the organism involved it should protect them from the disease. With this object in view a horse was given repeated and increasing doses of toxin until its blood serum was highly charged with antitoxin. It may be of some interest to give a little general information about this experiment.

Most of the work on the toxin responsible for the disease has been done on mice. It would obviously be too expensive to use large numbers of lambs. So far as could be estimated from the small number of lambs that were used, it took approximately 1,000 times as much toxin to kill a lamb as was needed to kill a mouse. At the time the serum of the horse mentioned above was ready for use it was of such strength in antitoxin that $\frac{1}{10000}$ cubic centimetre was enough to neutralize the amount of toxin that would kill a mouse; in other words, 1 cubic centimetre (about 17 drops) would be enough to protect 10,000 mice against just sufficient toxin to kill them. It follows, then, that since to kill a lamb required 1,000 times as much toxin as would kill one mouse, a cubic centimetre of the horse's serum would be enough to protect a lamb against ten times as much toxin as would be sufficient to kill it. It was decided to inoculate about 1,000 lambs on affected farms, giving each one a dose sufficient to protect it against fifty times the amount of toxin that would be just enough to kill it.

Antitoxin is troublesome to prepare, and if a vaccine were also found to be effective in protecting lambs it would be a more economic procedure to use it than to prepare antitoxin. For this reason, although it was felt from the outset that a vaccine was less likely to be effective, it was decided to try its effect also. (For the information of those who are conversant with the subject it may be mentioned that the vaccine comprised formalin-toxoided whole culture, filtered through paper-pulp to remove coarse particles.) The difference between vaccines and antitoxins, in their effect, is that the antitoxin gives an immediate protection, which is high to start with but gradually fades away, till after a few weeks only traces are left, whereas a vaccine of this sort stimulates the animal's body to produce antitoxin for itself. It takes some days for the body to produce antitoxin in response to an injection of vaccine, and, moreover, the degree to which this is done

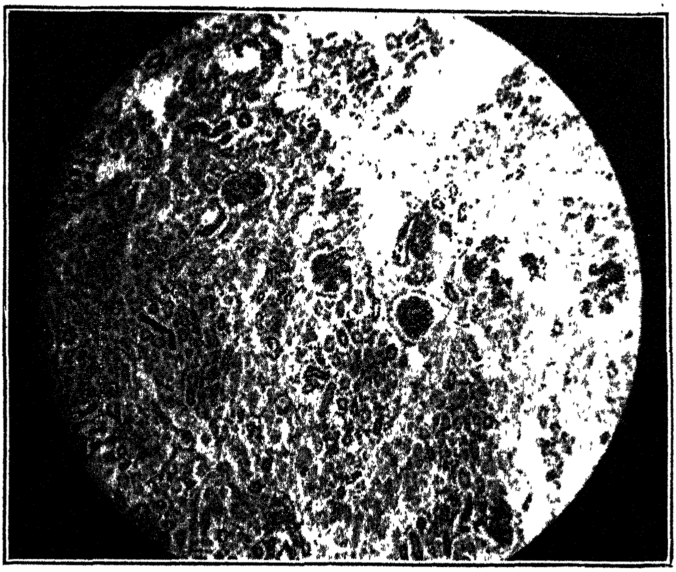

FIG. 3. SAME LAMB AS IN FIGS. 1 AND 2: KIDNEY EIGHTEEN HOURS AFTER DEATH.

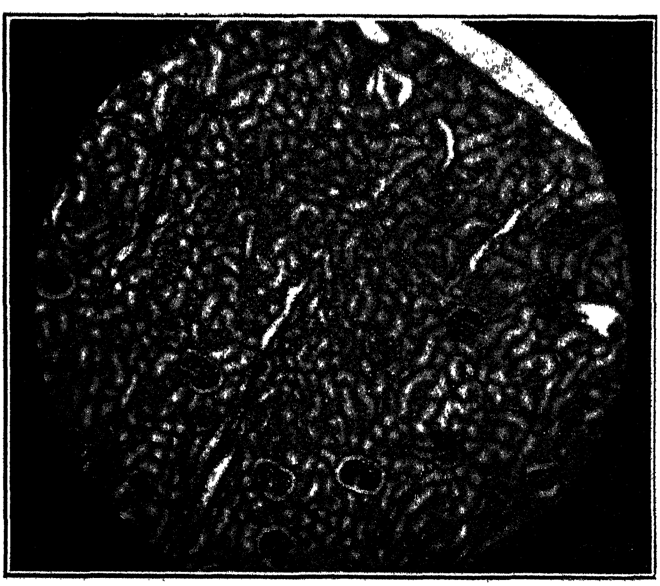

FIG. 4. NATURAL CASE OF PULPY KIDNEY, WITH SMALL-GUT CONTENTS HIGHLY TOXIC: LAMB KILLED AT POINT OF DEATH AND PORTION OF KIDNEY IMMEDIATELY REMOVED.

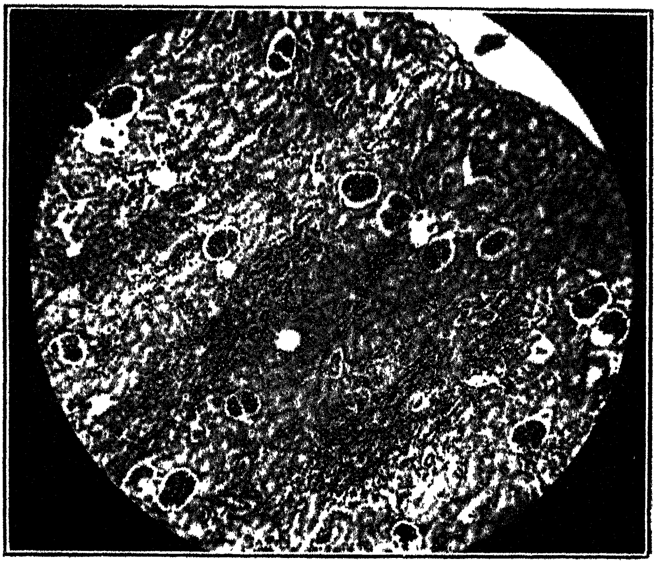

FIG. 5. SIMILAR CASE TO THAT IN FIG. 4, BUT LAMB DEAD TWO HOURS WHEN PORTION OF KIDNEY REMOVED. COMPARE WITH FIG. 2.

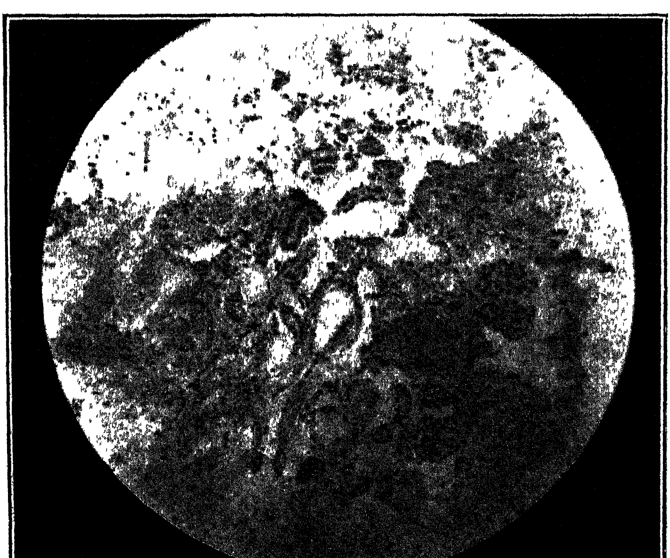

FIG. 6. NATURAL CASE OF PULPY KIDNEY: LAMB DEAD FROM TWELVE TO EIGHTEEN HOURS WHEN SPECIMEN TAKEN. COMPARE WITH FIG. 3.

varies a great deal from one animal to another—some respond well to a single injection, whereas others scarcely respond at all. This will be sufficient to explain why one had little expectation of the vaccine being beneficial, but was decidedly hopeful regarding the use of antitoxin.

The experiments were carried out in the Ranfurly district of Central Otago, through the generous co-operation of a number of local farmers. Only farms which were known to have had losses annually for some years past were selected, and the farmers themselves chose the particular paddocks in which they had suffered their heaviest losses for the experiments to be carried out in. The ewes had wintered well and came to lambing in excellent condition with plentiful spring feed available, so that it was anticipated that the nutritional factor would come into play and a fairly heavy loss from pulpy kidney be experienced. This did not eventuate, however. The writer was present during the period when deaths are usually most frequent, and during that period there was a good fall of rain at least once a week. The consequence was the the feed was not only plentiful *but was much softer, and longer than usual.* In the writer's opinion this was the principal factor in the low death-rate experienced throughout that period, as the feed was of such a nature that there would be less tendency than usual for digestive disturbances to occur (and give the pulpy kidney organism its opportunity) when the lambs started grazing at two to three weeks of age.

The practice followed was to vaccinate, or inoculate with antitoxin, approximately half the lambs in a given paddock leaving the rest as controls. Vaccination was carried out as far as possible when the lambs were under ten days old, in order to give them time to react to it before they reached the most susceptible age. The antitoxin was used in mobs of lambs where deaths were already occurring, and was often given concurrently with " tailing " operations.

Owing to the few deaths which occurred, either among the experimental lambs or the controls, the results are not very conclusive, but it can definitely be said that, whereas the vaccine had little or no effect, the antitoxin results appear to be very promising indeed. Results with the individual lots of lambs are shown in Tables 2 and 3.

The " doubtful " cases recorded in the tables were almost certainly not due to pulpy kidney, but so that there can be no possible question of bias in recording the results, all deaths occurring after the experiments began and which were not definitely attributable to some other cause have been included. In fairness it may be pointed out that while the

Table 2.—Vaccination Experiments with Lambs.

Owner.	Vaccinated.	Deaths.	Controls.	Deaths.
W.B.	100	0	70	1
L.S. (1)	152	2 (doubtful)	102	3
L.S. (2)	100	3	84	3
L.S. (3)	148	1 (doubtful)	97	0
S.B.	125	2	96	3
J.C.	102	1	100	2
Totals	727	9 (3 doubtful)	549	12

Table 3.—Antitoxin Experiments with Lambs.

Owner.	Antitoxin inoculated.	Deaths.	Controls.	Deaths.
J.D.	155	1 (doubtful)	174	1
E.C. (1)	55	0	60	1
E.C. (2)	100	0	90	0
A.H. (1)	120	1	135	1
A.H. (2)	100	0	82	0
J.K.	125	0	96	0
G.P.	145	1 (doubtful)	215	2 (doubtful)
D.L.	102	0	139	13
W.B.	75	0	72	2
Totals	1,067	3 (2 doubtful)	1,072	20 (1 doubtful)

lambs given antitoxin each received enough to protect against fifty times as much toxin as will kill a lamb, it may be that an occasional lamb will be affected with much more than that amount of toxin. This may explain the single definite pulpy kidney case which occurred among all those given antitoxin. Against this, compare the quite striking result obtained in the case of D.L.'s lambs (Table 3).

Conclusions.

Pulpy kidney disease of lambs is due to the absorption of a powerful bacterial poison, or toxin, from the small intestine. This toxin is produced in the intestine by an organism so closely resembling Bennetts's *B. ovitoxicus* that the writer suggests it be called "*Bacillus ovitoxicus* var. *N.Z.*" This organism can only function in the lamb's small intestine when the conditions therein are suitable for its growth and multiplication. In the writer's opinion the principal factor in rendering the conditions in the lamb's intestine suitable is a digestive disturbance occurring at the time the lamb starts grazing at two to three weeks of age. Field trials of a vaccine and antitoxin with a view to protecting lambs against the toxin produced in their intestine suggest that while the vaccine was of little or no value the antitoxin was definitely effective.

Acknowledgments.

My thanks are due to Mr. C. V. Dayus, M.R.C.V.S., District Superintendent of the Department of Agriculture in Dunedin, for kindly making many of the preliminary arrangements for field experiments mentioned in this article, and for collecting much of the data. Thanks are also extended to the farmers who were good enough to place their lambs at our disposal.

References.

(1) Gill: *N.Z. Journ. Agric.*, Vol. 44, 1932.
(2) Montgomerie: *Veterinary Journal*, Vol. 87, 1931.
(3) Bennetts: Australian C.S.I.R. Bulletin 57, 1932.
(4) Oxer: *Journ. of Aust. C.S.I.R.*, February, 1932.
(5) Gill: *N.Z. Journ. Agric.*, Vol. 42, 1931.
(6) Dalling: Annual Congress British N.V.M.A., 1928.
(7) McEwen: *Journ. Comp.: Path. and Ther.*, Vol. 43, 1930.

Noxious Weed Order.—The Patea County Council has declared tauhinu or New Zealand cotton-wood to be a noxious weed within that county.

TURNIP MANURING EXPERIMENTS IN THE SOUTH ISLAND, SEASON 1931-32.

Fields Division, Department of Agriculture.

THE results of fifty-eight turnip or swede manuring experiments conducted during the seasons 1924–25 to 1930–31 were summarized in the *Journal* for March and April, 1932. It was intended to continue the investigations outlined in Section 3 of the summary—" Comparison of super plus carbonate of lime with basic super "—during the 1931–32 season, and eight experiments were laid down in the South Island. On account of the extcmely dry conditions prevailing at the time these trials were sown the germination in some cases was a total failure; in others the " strike " was so poor that the trials were not considered worth proceeding with, and only three were carried to completion. The results of these experiments are given in the matter which follows.

TYPE OF EXPERIMENT.

The treatments per acre in the type of experiment adopted were as follows:—

(1) Superphosphate 1 cwt. plus carbonate of lime 1 cwt.
(2) Super 2 cwt. plus carbonate of lime 2 cwt.
(3) Basic super (special) 132 lb.
(4) Basic super (special) 264 lb.
(5) Commercial basic super 119 lb.
(6) Commercial basic super 238 lb.

The superphosphate used was the commercial grade containing 44–46 per cent. tricalcic phosphate equivalent. The method of preparing " special " basic super was described in the *Journal* for April, 1932, and the probable ingredients of commercial basic super were also discussed. The guaranteed analysis of the commercial basic super used in the 1931-32 season's trials gave the phosphate content to be equivalent to 19 per cent. of phosphoric anhydride. Treatments 1, 3, and 5 specified above therefore supplied equivalent quantities of phosphate, and these contained half the quantity of phosphate of that in treatments 2, 4, and 6 respectively.

Ten replications of each treatment were sown. Each plot was 2 chains long by one width of a 7-coulter drill, and the crops were either in 7 in. or 14 in. drills according to the practice in the district.

Germination counts were taken on each crop when the plants were in the two-leaf stage. The method of determining field germination was described in the *Journals* for July, 1926, and October, 1928.

PARTICULARS OF TRIALS.

As previously stated, only three out of the eight trials laid down were carried on, due to the abnormal weather conditions, and the particulars of these individual trials are given below, together with the results which appear in Tables 1 to 3.

(1) CO-OPERATING FARMER: G. H. CROSS, OXFORD.

Previous crop: Grass, five years. Crop sown: 17/12/31. Variety: Webb's Imperial Green Globe—10 oz. per acre in 14 in. drills. Germination counts taken: 1/3/32. Crop weighed: 7/6/32.

Table 1. Results of G. H. Cross's Experiment.

Treatment per Acre.	Germination Counts.		Yield in Tons per Acre.
	Average Number of Plants per Area, 10 ft. × 14 in.	Relative to Super 2 cwt. plus Lime 2 cwt. = 100.	
Super 1 cwt. plus carbonate of lime 1 cwt.	16·6	98·2	20·7
Super 2 cwt. plus carbonate of lime 2 cwt.	16·9	100·0	24·5
Basic super (special) 132 lb.	14·1	83·4	19·9
Basic super (special) 264 lb.	10·8	63·9	23·3
Commercial basic super 119 lb. ..	13·0	76·9	18·2
Commercial basic super 238 lb. ..	11·4	67·5	21·9

Comments on Table 1.—Germination: There is no significant difference in this respect between super plus carbonate of lime at 2 cwt. and at 4 cwt. per acre. Both, however, are significantly higher than the remainder. The germination of special basic super, 132 lb., is not significantly different from that of commercial basic super, 119 lb., but both gave significantly higher germination than the larger quantities of the respective fertilizers.

Yield: The use of the larger quantity of each fertilizer has resulted in significantly better yields than the use of the smaller quantity of the corresponding fertilizer. Commercial basic super, at 119 lb. and 238 lb. respectively, has given significantly lower yields than the equivalent quantities of special basic super and super plus carbonate of lime. Differences between the two latter were not significant.

(2) W. SYME, KIMBERLEY.

Previous crops: Wheat, 1930–31; grass, 1929–30. Crop sown: 31/12/31. Variety: Imperial Green Globe, 9 oz. per acre, in 14 in. drills. Germination counts taken: 24/2/32. Crop weighed: 17/5/32.

Table 2.—Results of W. Syme's Experiment.

Treatment per Acre.	Germination Counts.		Yield in Tons per Acre.
	Average Number of Plants per Area, 10 ft. × 14 in.	Relative to Super 2 cwt. plus Lime 2 cwt. = 100.	
Super 1 cwt. plus carbonate of lime 1 cwt.	9·5	90·5	7·5
Super 2 cwt. plus carbonate of lime 2 cwt.	10·5	100·0	8·0
Basic super (special) 132 lb.	6·5	61·9	8·1
Basic super (special) 264 lb.	5·1	48·6	8·9
Commercial basic super 1 cwt.* ..	6·9	65·7	7·0
Commercial basic super 2 cwt.* ..	5·3	50·5	6·5

*The quantities used here were based on the actual analysis of the basic super, which was equivalent to 44·7 tricalcic phosphate.

Comments on Table 2.—Germination: As in Experiment 1, there was no significant difference between the two super plus carbonate of lime treatments. Both had a significantly higher germination than the remainder. The use of 1 cwt. of commercial basic super and special basic super respectively gave a significantly greater number of plants than 2 cwt. of the corresponding fertilizer.

Yield: In view of the poor strike and patchiness of the crop it would be unwise to draw conclusions from the yields of the various treatments. An interesting point observed at maturity of the crop was that special basic super 264 lb. was free of the slight percentage of club-root found in other plots.

(3) G. H. ROSE, WAKANUI.

Previous crop: Grass. Crop sown: 12/2/32. Seeding: 8 oz. per acre in 7 in. rows. Germination counts taken: 1/3/32. Crop weighed: 29/6/32.

Table 3.—Results of G. H. Rose's Experiment.

Treatment per Acre.	Germination Counts.		Yield in Tons per Acre.
	Average Number of Plants per Area, 10 ft. × 14 in.	Relative to Special Basic Super 132 lb. = 100.	
Super 1 cwt. plus carbonate of lime 1 cwt.	15·0	90·5	25·0
Super 2 cwt. plus carbonate of lime 2 cwt.	14·2	85·5	26·2
Basic super (special) 132 lb.	16·6	100·0	25·4
Basic super (special) 264 lb.	13·4	80·7	26·4
Commercial basic super 119 lb. ..	15·8	95·2	25·8
Commercial basic super 238 lb. ..	14·2	85·5	25·5

Comments on Table 3.—Germination: Special basic super 264 lb. had a significantly lower germination than special basic super 132 lb.

Yield: There were no significant differences between the yields of various treatments.

GENERAL COMMENTS.

Except in the case of Experiment 3, the special basic super and the commercial basic super gave a significantly lower number of plants than the corresponding quantities of super plus carbonate of lime.

In the case of special basic super, however, this did not appear to be reflected in lower yields, and in the average of the three trials the yields of special basic super are practically identical with the equivalent quantities of super plus carbonate of lime. The average yield of commercial basic super is, however, slightly less.

The use of the larger quantities of special basic super and the super plus carbonate of lime has resulted in an approximate increase of 2 tons per acre on the average, and in the case of commercial basic super the average increase was 1 ton per acre.

In each of the three experiments a plot sown for observation with 2 cwt. per acre of superphosphate without lime gave a very small yield, as the germination in each case was extremely poor.

Recommendations to Growers.

It may be advisable to reiterate statements previously made in regard to the adverse effect of super used without lime. In thirty-one trials conducted up to the present time where 1 cwt. of super could be compared with no manure, ground rock phosphate, or super plus carbonate of lime in equal parts (seed and manure in 14-in. rows) the super reduced the germination, on the average, to 65·5 per cent. of that occurring with the other treatments mentioned. Super at 2 cwt. per acre had a still greater effect on germination when sown with the seed in 14-in. rows. A comparison of super 2 cwt. with plots sown with super 2 cwt. plus carbonate of lime 2 cwt. in fourteen experiments shows that the germination of super 2 cwt. was 43·2 per cent. of that in the super plus lime plots.

In order to avoid, as far as possible, such adverse effect from the use of superphosphate with the turnip crop, farmers are advised to act on the following points:—

(1) Mix superphosphate and carbonate of lime (equal parts) at least one week before sowing. The mixture should be left in a heap, as it tends to set hard if put into bags. If left in a heap it can be easily broken up before use.

(2) Use 2 cwt. per acre of the mixture on light land, and 4 cwt. on heavier land of higher rainfall.

(3) Sowing seed and manure in 7-in. rows, instead of adopting the more common practice of sowing in 14-in. rows, has given promise of good results.

(4) If super is used without lime, the method of sowing mentioned in (3) above is recommended, or part of the super should be predrilled or post-drilled in the manner described in the *Journal* for April, 1932.

(5) The use of commercial basic super is not recommended in preference to the super plus carbonate of lime mixture. Further investigation regarding the use of the special basic super is necessary before any definite recommendation regarding its use can be made.

Mixtures of super and slaked lime in varying proportions are being tested against the super plus carbonate of lime mixture which is at present recommended.

The co-operation of those farmers who placed facilities at the disposal of the Department for carrying out these trials is cordially acknowledged. It is unfortunate that climatic conditions did not allow all the experiments laid down to be brought to a satisfactory conclusion. The field work in Experiments 1 and 2 was carried out by Mr. G. G. Calder, Instructor in Agriculture, Christchurch, and in Experiment 3 by Mr. E. M. Bates, Instructor in Agriculture, Ashburton, under the direction of Mr. R. McGillivray, Fields Superintendent, Christchurch.

—*A. W. Hudson, Crop Experimentalist, and J. W. Woodcock, Assistant Crop Experimentalist.*

SOME ASPECTS OF OVERRUN IN HOME-SEPARATION BUTTERMAKING.

Paper by D. HULL, Dairy Instructor, Dairy Division, Department of Agriculture, at the Annual Meeting of the New Zealand Dairy Factory Managers' Association, Palmerston North, June, 1932.

THE object of this address is not to treat exhaustively on the subject, but to give a review of the factors that influence the percentage of overrun obtainable in dairy-factory practice during a season's operations. Much of the data that will be quoted was obtained from observations made during a survey of overrun carried out by the Dairy Division in conjunction with five dairy companies during January of this year, and may prove to be of interest to those desirous of a fuller understanding of the factors governing overrun.

The dairy industry of this Dominion has been built up on practical work, and factory practice includes the ascertaining of the fat content and other constituents of cream and butter by practical tests. As laboratory methods of testing are outside the province of practical dairy-factory work they are omitted. Mathematical precision is unattainable with practical tests, but, so far as our experience goes, practical tests operated with due care give all the accuracy needed for commercial purposes.

The "factory" or "balance-sheet" overrun may be defined as the difference between the total butterfat that is paid for by a factory and the total of the butter for which the factory receives payment.

It is often asked, "What should an overrun be on the home-separation system?" This question is somewhat involved owing to the varying conditions existing in and around our butter-factories. The source, type, and quantities of the individual supplies of cream have a direct bearing on the possible overrun. To state definitely what the overrun should be in all factories would be obviously unfair to those factories where conditions are such that anything beyond a normal average is impossible of achievement if all suppliers get their due.

The purpose of this paper is not to indicate an arbitrary overrun, but a range in overrun is suggested for consideration. The basing of a factory-manager's efficiency on his capability to obtain a high overrun is fundamentally wrong, and has done much to bring about a spirit of restlessness concerning the pay-out of competing companies. It has forced some managers to present an overrun which they know is not in keeping with the butterfat content of the butter made under their control. It is generally conceded that, whatever the overrun may be, it is reasonable to expect that the dairy company should be in a position to justify it and also indicate that each individual supplier was given his due.

The butterfat content of the butter is the concrete base on which an overrun is built. The structure of the overrun is largely affected by the fat losses in the buttermilk, and other mechanical losses. The legal mechanical gains may be viewed in the light of reinforcing, and as a set-off against the weakening brought about by unavoidable mechanical losses during the course of manufacture.

The salient points—namely, the butterfat content of the butter, and churning and handling losses—give ample scope for an efficient manager to demonstrate his ability. While the efficient manager recognizes these two points, and endeavours to do the correct thing by his suppliers, he is placed at a disadvantage by the manager who displays little or no interest in the butterfat content of the butter and the manufacturing losses; and then presents an overrun, which, if it is not analysed, is just low enough to appear to be a fair thing. This position has arisen through some directors insisting that their factory-manager should have as high an overrun as the competing factories, without giving thought to the butterfat content of the manufactured butter.

It is just as important for a board of directors to know the average butterfat content of the butter, and the percentage of butterfat lost in the buttermilk, as it is to know the quantity of butter made and the overrun. In the past some have considered these vital points to be mere window-dressing; but the directors of a dairy company, the business of which is to make butter, should insist that these all-important facts, which have so great an influence on the true pay-out, are presented to the board at each meeting. No true opinion of an overrun can be expressed without knowledge of the facts mentioned.

Speaking generally, the highest overruns are obtained by those factories whose butter has the lowest butterfat content. This raises the question as to what could be considered to be the lowest butterfat content that a factory could average for a season. Regulations fix a maximum water and salt content for export butter at 16 per cent. and 2 per cent. respectively. 15·9 per cent. can be considered to be the maximum water content, and 1·9 per cent. the maximum salt content that could be averaged by a factory for a year. Other than the butterfat, the remaining constituents by short analysis of the butter are curd and ash. Dairy Division experience has been that the curd and ash content of New Zealand butter seldom exceeds 0·9 per cent., and we have yet to learn of any factories averaging over 0·9 per cent. of curd and ash for a season. Therefore, 0·9 per cent. could safely be considered to be the maximum average content obtainable in this Dominion.

With 15·9 per cent. average moisture, 1·9 per cent. average salt, and 0·9 per cent. average curd and ash contents, one would have 81·3 per cent. of butterfat. 81·3 per cent. of butterfat can confidently be considered to be the *minimum* average butterfat content for export butter, and I am of the opinion that no factory in this country has had an average butterfat content for export butter this season as low as 81·3 per cent. I will refer to this figure again later.

At this stage I wish to stress the fact that the striving for high moisture content is often responsible for overworked butter, and its attendant evils of "flat" flavour and reduced "keeping" quality. Speaking as I am to a gathering of skilled makers, you will follow my meaning when I say that the working process should be stopped when the body and texture of the butter is "just right," rather than carry on to overworking for a small percentage of extra moisture content. We must not lose sight of the fact that quality must be foremost.

The apparent gain of a small percentage of extra moisture is too costly if made at the expense of quality.

It is also desired to stress the point that butters containing 1·8 to 2 per cent. of salt are too highly salted for the best trade in the United Kingdom. It would not be in the interests of the extension of the consumption of New Zealand butter if all our butter contained this high percentage of salt. Factory-managers who are endeavouring to make a butter which will best please customers in the high-class trade will, it may be assumed, be endeavouring to keep the salt content in the vicinity of 1·6 to 1·7 per cent. We have received information that a section of the trade in the United Kingdom consider that butter containing 1·7 per cent. is just over the border of salting for their best trade. Nationally we are sellers of butter, not buyers. We have to realize that we must give those who buy from us just what they ask for, and not what we may consider to be "near enough."

Mechanical Losses of Butterfat.

I now wish to touch on the matter of unavoidable losses in manufacture. The butterfat lost in the buttermilk constitutes the greatest percentage of the total losses. The skill and knowledge of the factory-manager have a direct bearing on this loss. Our investigations show a range of from 1·033 per cent. to 2·614 per cent. of the total fat as being lost in the buttermilk. Correct temperatures and correct pasteurizing and cooling equipment are necessary if this loss is to be reduced to a minimum. Restricted outlets from pasteurizers, the use of certain types of cream pumps, and neglecting to thoroughly stir the cream in the holding vats are prime causes of undue loss of fat in the buttermilk. With the equipment used in New Zealand factories at the present time, it is unlikely that any factory would lose less than 1 per cent. of its total butterfat, in the buttermilk, for a season.

The average loss of fat sustained in a well-managed factory by giving away 2 oz. of butter per box can be put down as representing 0·233 per cent. of the total butterfat. This figure was fairly constant in our experimental work. Some work was also done in connection with the butterfat content of butter wash-water. Some samples gave a reading as high as 0·02 per cent. with the butyl alcohol test.

The amount of butterfat lost in manufacture due to cream samples, spillage, adherence to cans, vats, churns, &c., varies considerably and cannot be exactly determined. It is thought by some that practically no loss occurs under this heading. But it is not physically possible to handle cream and make butter without these losses, which are constant. They can be fairly assessed at 0·5 per cent. of the total butterfat received. If the handling losses were as low as 0·25 per cent. or as high as 0·75 per cent., the overrun would only be affected by approximately 0·3 per cent. either way. While congratulating the ultra-careful manager on reducing spillage and handling losses to a minimum, his zeal in this connection does not lift the overrun to the extent that some suppliers believe. It is also recognized that the percentage of butterfat lost in handling is greater in a small factory than in a large one.

Experiments and investigations have shown that the minimum manufacturing losses in a well-managed factory are in the vicinity of: Buttermilk, 1·0 per cent.; butter trade allowance, 0·233 per cent.;

handling, spillage, &c., 0·5 per cent.—making altogether 1·733 per cent. of the total fat. I wish to make it quite clear that these figures should be taken as a *minimum*. Our experience has been that this minimum has seldom been obtained.

As an indication of the variations in mechanical losses that do and will occur as between factories the following figures are given :—

Factory.	Fat in Buttermilk.	Fat in Butter Trade Allowance.
	Per Cent.	Per Cent.
A	1·033	0·2618
B	1·149	0·181
C	2·614	0·2312
D	1·251	0·217

Factory C experienced heavy churning losses on account of the type of machinery used for pasteurizing and cooling, and must be taken as being exceptional.

The *average* total butterfat loss in the average factory may be considered to be: Butterfat in buttermilk, 1·144 per cent.; butterfat in trade allowance, 0·233 per cent.; spillage, handling, and sampling losses, 0·7 per cent.—making 2·077 per cent. of the total butterfat.

It may be considered by some that an average of 0·7 per cent. for the items of spillage, handling, &c., is on the high side; but the fact has to be acknowledged that cream sampling is nearly always in favour of the supplier, and although inaccuracy in sampling is not an actual loss the overrun is depreciated thereby.

To sum up on mechanical losses, these can be taken in round figures as representing 2 per cent. of the total butterfat received.

MECHANICAL GAINS ON CREAM AND CANS.

The Dairy Regulations provide that where the weight of cream received from a supplier is not an exact number of half pounds it shall be recorded at or above the nearest half pound below the exact weight; and if the cream is weighed in a container, and the container weighs an exact number of half pounds, the tare of the container shall be computed accordingly; and where the weight of the container is not an exact number of half pounds the tare shall be computed at or below the nearest half pound above the weight of the container. Thus it will be seen that it is possible to gain up to 7 oz. on the weight of a parcel of cream, and up to 7 oz. on the tare weight of the can.

In the first case the law of averages will operate, and the average gain on the weight of each parcel of cream will be 3½ oz. In the second case the law of averages will take charge at the time the cans are manufactured, but there is a chance that a majority of the cans going to a butter-factory may be of such weights as to constitute a greater gain than the average can would give. Nevertheless, the average theoretical gain on the tare weight of each can is 3½ oz., and it would appear that the time has arrived when dairy companies should check up the weights of the cans received, and bring the weights of each can to the nearest pound or half pound. Briefly, the law of averages provides that the mechanical gains in weighing cream and cans will be approximately 0·875 per cent. of the total butterfat.

Our experience over a period of ten days at different factories gave the following variations in gains on cream weights and can tare weights :—

Lowest gain on tare of cans over a period of 10 days=0·159 per cent. of total butterfat.

Highest gain on tare of cans over a period of 10 days=0·438 per cent. of total butterfat.

Lowest gain on fractions in weighing cream over a period of 10 days= 0·211 per cent. of total butterfat.

Highest gain on fractions in weighing cream over a period of 10 days= 0·361 per cent. of total butterfat.

Combining the gains on fractions of cream and gains on the tare weight of cans, the following figures result :—

Lowest bracketed gains on cream and cans over a period of 10 days= 0·381 per cent. of total butterfat.

Highest bracketed gains on cream and cans over a period of 10 days= 0·799 per cent. of total butterfat.

Although no single factory during the experimental work averaged as high a gain under these headings as the theoretical gain based on the law of averages, that does not prove that the law of averages will not obtain over a season's operations.

MECHANICAL GAINS ON TESTS.

When cream tests are being read at a factory it is usually the practice to read to the nearest 1 per cent., and half points and smaller fractions are retained by the factory. Some factories, however, do not follow the good policy of "give and take," but take advantage of all fractions of tests up to 0·9 per cent. Thus, the average gain of this type of factory will be approximately 1·125 per cent. of the total butterfat.

Our experience at different factories over a period of ten days gave the following variations in gains on cream-test fractions :—

Lowest gain on fractions of cream tests over a period of 10 days = 0·563 per cent. of total butterfat.

Highest gain on fractions of cream tests over a period of 10 days = 1·305 per cent. of total butterfat.

Although one factory during the experimental work of ten days' duration did average a higher gain under this heading than the theoretical gain, that does not prove that the law of averages will not obtain over a season's operations. I think that it will be agreed that the average mechanical gains on the fractions of cream tests are too high a percentage of the butterfat received. This particularly applies to the factory that does not "give and take."

I would draw attention to a later type of cream test bottle that was introduced to this Dominion by Massey Agricultural College. This is a 9-gramme 50 per cent. bottle graduated to 0·5 per cent. and read direct. This obviates the doubling of the reading as is the case with the ordinary 30 per cent. bottle. As the bottles are graduated to 0·5 per cent. the half points are clearly defined, and in many instances a quarter point is obvious. It is recommended that this new type of bottle be used in future, and that no further orders for 30 per cent. bottles be given.

A further gain accrues if a factory does not pay for the fractions below 1 lb. in weight of the supplier's total weight of butterfat for the testing period or the month. Some company secretaries adopt the "give and take" principle when getting out the monthly butterfat statements. Others take the fractions from all three periods of the month. Experiments in conjunction with the Dairy Division have shown a possible gain of 0·3 per cent. of the total butterfat paid for if all fractions under this heading are taken. Those responsible for figuring the period and monthly butterfat totals are strongly recommended to adopt the "give and take" principle, as a factory is not likely to lose by so doing.

Total Mechanical Gains.

Summing up the *total* mechanical gains, our experience at different factories over a period of ten days gave the following variations:—

Lowest total over a period of 10 days = 0·944 per cent. of total butterfat.

Highest total over a period of 10 days = 2·077 per cent. of total butterfat.

The theoretical total of gains, based on the law of averages, would be approximately 2 per cent. of the total butterfat. But the average total gains in five factories during the same period of experimental work did not reach that figure. This, however, does not prove that the law of averages would not obtain over a season's operations.

Other Considerations.

Earlier in this address I referred to the matter of the source, type, and quantities of the individual supplies of cream to a factory. I would here mention that the factory with the greatest number of daily suppliers per ton of butter manufactured will average the greatest percentage of mechanical gains, particularly if each can is weighed separately.

Before a maximum overrun could be fairly fixed, conditions such as I have just mentioned would also need to be fixed. This is impossible of achievement. It has been demonstrated that it is possible for the mechanical gains to equal and counterbalance the mechanical losses, but I wish to make myself quite clear when I say, "Do not go back to your factories feeling convinced that *your* gains will always equal *your* losses; that can only be the case when your mechanical losses are low, and when the source, type, and quantities of the supplies of cream are such as to warrant your mechanical gains." It is my personal conviction that in most factories the losses are heavier than the gains over a season.

Reiterating the fact that the butterfat content of the butter is the concrete base on which overrun is built, and allowing that under well-defined circumstances it is possible for the gains to equal the losses, the conclusion is that it is also possible for the "factory" or "balance-sheet" overrun to equal and be in line with the overrun based on the average composition of the butter manufactured for the year.

I said earlier that I would again refer to what could confidently be considered to be the minimum average fat content for export butter

for a season, the composition being as follows: Butterfat, 81·3 per cent.; water, 15·9 per cent.; salt, 1·9 per cent.; curd and ash, 0·9 per cent.: total, 100 per cent. If it is possible to average this composition, then the "composition" overrun would be 23·0 per cent. and a "factory" or "balance-sheet" overrun of 23·0 per cent. could be justified; but any excess of mechanical losses over mechanical gains would, of course, reduce this overrun accordingly.

The average composition of the butter exported from New Zealand is very near the following: Butterfat, 82·0 per cent.; water, 15·5 per cent.; salt, 1·7 per cent.; curd and ash, 0·8 per cent.: total, 100 per cent. Under exceptional circumstances with this average composition the "factory" overrun could be 21·9 per cent., which is the same as the overrun on the composition of the butter. As with the previous overrun, any excess of mechanical losses over mechanical gains would reduce the overrun accordingly.

STANDARDIZING OF OVERRUN.

It has been suggested that the overrun in butter-factories should be standardized, and that all butterfat exceeding certain prescribed limits should be credited back to the suppliers as such, and not included as overrun.

Consideration has been given to other methods of payment for butterfat, and the conclusion arrived at is that any other methods of payment would be more costly to use. The present method is a satisfactory one, provided that it is operated in a fair spirit. If overruns were standardized it is to be expected that the maximum would soon become the minimum—in fact, some directors would possibly demand it, and it is possible that some managers would soon be in the position of publishing a higher overrun than they could justify by the average butterfat content of the company's butter.

CONCLUSION.

In conclusion I wish to say that as a dairying country quality must always come first with us. Striving for 15·9 per cent. of moisture, 1·9 per cent. of salt, and an excessive curd content, is not in the interests of quality. Our best butters are not made on these lines. As makers, you know this to be true. Butter containing 0·9 per cent. of curd and ash could be termed a doubtful keeper. Any considerations such as I have just mentioned should be made subversive to quality. If overrun is placed before quality, then it may be said definitely that the principle is commercially unsound.

Testing of Export Butter for Moisture and Salt Content.—The annual report of the Dairy Division for 1931–32 refers to this matter as follows: "The usual practice of testing a box from each churning of butter sent forward for grading was followed, and during the year 153,985 churnings were tested. A high degree of accuracy in the incorporation of water in the butter has been maintained by buttermakers, and only 0·4 per cent. of these churnings exceeded the legal limit of 16 per cent. The butter showing excess water was, of course, not exported. In addition, 99,015 samples were tested for salt content, the legal requirement of which ranges from 1·5 to 2 per cent. A tolerance of 0·25 per cent. below the legal minimum has been permitted, and a very small percentage of churnings was

SEED CERTIFICATION.

SUMMARY OF OPERATIONS FOR SEASON 1931–32.

(Concluded from November.)

Reported by J. H. CLARIDGE, Assistant in Agronomy, Department of Agriculture.

Seed Wheat.

The results of the introduction of fixed standards in connection with wheat certification in 1930–31 are shown in the figures for the 1931–32 season. In the latter season, of fifty-seven farmers' crops inspected, only one crop was rejected on account of the presence of a high percentage of loose smut, while five crops were rejected on account of a high percentage of foreign varieties. Of these five, two rejections were attributable to the fact that some other variety of wheat had first been sown, but had not given a satisfactory strike.

Table 7.—Seed-wheat Certification: Number of Areas and Acreage inspected and passed in the Field, Season 1931–32.

Variety.	Areas inspected.		Areas passed.	
	Number.	Acreage.	Number.	Acreage.
Solid-straw Tuscan ..	22 (76)	503 (2,178)	16 (9)	382 (129)
College Hunter's II ..	20 (2)	335 (25)	15 (2)	273 (25)
Other varieties ..	22 (58)	225 (1,086)	16 (16)	155 (231)
Total	64 (136)	1,063 (3,289)	47 (27)	810 (385)

Table 8.—Seed-wheat Certification: Quantities branded in the Paddock and Machine-dressed, Season 1931–32.

Variety.	Areas passed Grain Inspection.		Number of Sacks branded in Paddock.	Bushels of Seed going into Machines.	Bushels of Machine-dressed Seed obtained.	Percentage of Loss in Machine-dressing.
	Number.	Acreage.				
Solid-straw Tuscan	7 (4)	106 (71)	621 (815)	.. (1,686)	.. (1,540)	.. (8·7)
College Hunter's II	6 (2)	69 (25)	604 (538)	509 (129)	468 (107)	8·1 (17·1)
Other varieties ..	7 (9)	78 (156)	539 (1,814)	944 (2,828)	815 (2,413)	13·6 (14·3)
Total ..	20 (15)	253 (252)	1,764 (3,167)	1,453 (4,643)	1,283 (4,060)	11·7 (12·6)

The other three rejections were crops of the College Hunter's variety, which has been replaced by a later selection, College Hunter's II. Reference to the 1930–31 records shows that at least 75 per cent. of the crops inspected in that season were rejected on account of one or other of the above-mentioned reasons. Twenty-eight of the crops which passed field inspection were subjected to the grain inspection. Eight of these were rejected, the high proportion being due to the seasonal conditions producing wheat unsuitable for seed purposes.

Tables 7 and 8 compare the results of the season's work with those of the previous season.

Seed Potatoes.

Final figures in connection with the total quantity of seed potatoes passing the tuber inspection in 1930–31 were not available when the summary of operations for that season was prepared. Table 9 gives these figures for the last five years, illustrating the increase in the quantity of seed tagged.

Table 9.—Potato Certification: Quantity of Potatoes finally certified.

Variety.	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.
	Tons.	Tons.	Tons.	Tons.	Tons.
Aucklander Short-top ..	18	85	176	390	438
Dakota	77	96	174	113	116
Aucklander Tall-top ..	14	14	50	73	81
King Edward	..	2	30	46	45
Epicure	..	..	13	37	9
Arran Chief	27	18	1	25	41
Other varieties	81	34	67	76	81
Total	217	249	511	760	811

There was a drop in the number of applications received for the 1931–32 season, a reduction of twenty-eight being recorded on the previous season's figures. This reduction may be accounted for in

Table 10.—Entries and Inspections of Seed Potatoes, Season 1931–32.

Item.	Number.			Percentage.			Acreage.		
	1931–32.	1930–31.	1929–30.	1931–32.	1930–31.	1929–30.	1931–32.	1930–31.	1929–30.
Crops entered ..	336	364	397	..	..	..	..	..	..
Crops withdrawn	34	17	34	..	..	..	..	..	..
Crops inspected	302	347	363	..	..	..	1,131	1,334	1,200
Crops rejected on account of rogues	11	23	84	3·6	6·6	23·5	25	83	..
Crops rejected on account of virus disease and cropping power	98	84	151	33·7	25·3	54·2	350	290	..
Crops provisionally certified	193	240	128	64·2	69·2	35·3	756	950	590

that in 1931 the potato market in New Zealand reached an unprecedented low ebb, with a resultant estimated reduction of 20 per cent. in the total area planted in the spring of 1931 as compared with that planted in 1930.

The position in regard to entries and inspections is given in Table 10, where the 1930–31 figures are also included. While there has again been a reduction in the percentage of crops rejected on account of foreign varieties, the percentage rejected for virus disease and cropping power shows an increase from 25 per cent. to 33 per cent. When it is mentioned that the standard for the 1931–32 crops was higher than previously, this increase is immediately explained.

Table 11 shows the distribution of all lines according to district of origin.

Table 11.—Seed Potatoes: Crops provisionally certified or rejected arranged according to District, Season 1931–32.

District.	Inspected.		Rejected. For Rogues.		Rejected. For Virus and Cropping Power.		Provisionally certified.	
	Crops.	Acreage.	Crops.	Acreage.	Crops.	Acreage.	Crops.	Acreage.
Manawatu	10	29	3	7	6	19	1	3
Wairarapa	3	4	..	..	1	1	2	3
North Canterbury ..	185	870	7	17	52	202	126	651
Mid-Canterbury ..	16	98	..	..	7	63	9	35
South Canterbury ..	35	85	1	1	19	49	15	35
North Otago ..	6	10	..	..	4	7	2	3
Otago	4	16	..	..	1	6	3	10
Southland	18	34	..	..	1	3	17	31
Total ..	277	1,146	11	25	91	350	175	771

NOTE.—This table does not include small areas of twenty-five varieties entered by the Government Pure Seed Station, Lincoln.

Table 12.—Potato Certification: Number of Crops and Acreage provisionally certified, 1929–30 to 1931–32.

Variety.	Number of Crops. 1929–30.	Number of Crops. 1930–31.	Number of Crops. 1931–32.	Acreage. 1929–30.	Acreage. 1930–31.	Acreage. 1931–32.
Aucklander Short-top ..	26	80	57	96	298	352
Dakota	27	58	29	132	270	145
Aucklander Tall-top ..	8	25	23	56	86	92
Arran Chief	3	5	13	6	18	26
King Edward.. ..	9	14	11	25	30	21
Up-to-date	2	5	11	3	11	22
Epicure	5	9	8	29	56	31
Iron Duke	1	6	5	12	23	7
Bresee's Prolific ..	7	8	4	78	107	31
Other varieties ..	14	24	31	43	45	44
Total	108	240	193	492	950	771
Average acreage of areas	..	..	..	4·6	4·3	4·4

The range of varieties provisionally certified, together with the acreage, is given in Table 12, where comparisons may be made with the two previous seasons.

The number of samples received in connection with the qualification trials fell from 218 in 1930–31 to 91 in 1931–32, a decrease which seems hardly explained by planting fluctuations. Further, the general standard of the lines entered, as given in Table 13, hardly came up to that of the previous season, even allowing for the tightening of the standards. In connection with this table, in Class A are included lines which are recommended for entry into certification, while Class B contains crops about the borderline, which the grower may enter if he feels so disposed. In Class C are placed the crops which are definitely of no value in certification.

Table 13.—Seed Potato Qualification Trials, Season 1931–32, showing Origin and Classification of Lines.

District of Origin.	Number of Varieties.	Number of Entries.	Number of Entries classified as				
			Class A.	Class B.	Class C.	Too mixed to judge.	Insufficient Commercial Importance.
Hawke's Bay - Manawatu	7 (3)	15 (5)	3 (1)	.. (1)	10 (2)	1 ..	1 (1)
North Canterbury ..	14 (36)	35 (132)	.. (32)	6 (24)	27 (51)	1 (17)	1 (8)
Mid-Canterbury ..	4 (4)	5 (11)	.. (6)	2 ..	3 (3)	.. (2)	.. ..
South Canterbury ..	10 (21)	19 (48)	1 (2)	2 (3)	14 (31)	2 (7)	.. (5)
North Otago ..	4 (3)	7 (3)	.. ..	1 ..	4 (2)	2 (1)	.. ..
Otago	3 (3)	3 (5)	.. ..	1 (2)	2 (1)	.. (2)	.. ..
Southland	4 (6)	7 (14)	2 (4)	4 (5)	1 (1)	.. (2)	.. (2)
Total ..	22 (52)	91 (218)	6 (45)	16 (35)	62 (91)	5 (31)	2 (16)

Seed Beans.

The certification of seed beans has proved to be very disappointing. Of all the Canadian Wonder crops inspected there were only two small areas in which no bean-wilt could be found. The seed sown on these areas was raised the previous season in an isolated area. Other varieties do not appear so susceptible to the disease, and of these a fair proportion was accepted.

Exportation of Stud Stock.—During the year ended 31st March, 1932, the following stud stock was exported from New Zealand: Sheep, 1,434; cattle, 46; swine, 11; horses, 11 (draught). There was the usual movement of racehorses to and from Australia.

SEASONAL NOTES.

THE FARM.

The Pastures.

A CONSIDERABLE proportion of the poor results obtained from the autumn sowing of pasture seed mixtures arises either from sowing at too late a date or from sowing on a coarse, poorly consolidated seed-bed. Frequently both late sowing and poor seed-bed are due to not allowing sufficient time for preparatory cultivation. Intensive tillage for a short period may be employed to produce a fairly well pulverized seed-bed, but it is advisable to remember that hurried tillage necessarily eliminates the action of natural weathering agencies which experience has shown to be of great service in producing economically the fine firm seed-bed that favours really successful pasture establishment.

If a seed-bed is not fine and firm the covering of seeds takes place at greatly varying depths, and consequently if some of the seeds are sown at a suitable depth others must be sown at unsuitable depths; in pasture seeds, which are relatively minute, the danger is that a substantial proportion will be buried so deeply as to make it impossible for seedlings to be established from them. As good pasture seed is relatively expensive it is as a rule not sown in excessive quantities. Indeed, probably the amount used is frequently inadequate to produce a sward of maximum efficiency. Hence poor seed-beds are particularly likely to lead to weaknesses appearing in pastures right from their initial stages. Even when possible, it is seldom easy to remedy such weaknesses. It must be concluded from these facts that the preparatory cultivation of land for new pastures should be commenced, as a rule, at least a few weeks before it is intended to sow the seed.

The seeds for pasture mixtures are at times purchased in a hurried haphazard manner. In view of the fact that the harmful influence of unsuitable mixtures may be felt over many years, it is much more important with permanent pastures than with annual crops to exercise great care in securing the seed best suited for the specific purpose. This at times cannot be done quickly, because several matters call for attention. Even when it has been decided what species are to be used and the quantities of each to be included, information has to be obtained about the strain and the germination capacity of the lines of seed offering. Hence it is clearly wise not to leave the purchase of pasture seed mixtures to the last day or so before their sowing, as is so often done.

Seed of poor type or poor germination capacity is at times offered at what seems to be an attractively low price. As a rule, such seed is markedly dear at such a price. Against this is the fact that each year considerable quantities of seed poor in strain or poor in germination find ready purchasers, thereby indicating that some farmers do not yet realize the true economy of good seeds for permanent pastures.

One of the most important recent advances in grassland is the more thorough knowledge of strain differences within certain important pasture species which formerly were widely accepted without question as being relatively uniform in character. It has been demonstrated strikingly that certain strains are outstandingly superior to others within the same species. No farmer can obtain full efficiency and ignore in his seed purchases the present knowledge of strain differences in pasture species. Full information regarding strains of pasture species and about pasture seed mixtures generally may be obtained by applying to local officers of the Fields Division.

Areas from which hay or silage has been saved will usually respond profitably to a dressing of superphosphate, especially if relatively early mowing has taken place and if the top-dressing is carried out as soon as the mown material has been removed. The quick stimulation of growth which can at times be obtained by the use of superphosphate in this manner is likely to be particularly valuable, because it leads to the provision of additional fresh grass at that critical period in summer when such fresh feed is apt to be harmfully scant.

Especially in a summer favourable for growth precautions should usually be taken to avoid the production of seed by recently sown pastures during their first year, and such precautions are particularly advisable if the young pastures were designed for permanent ones and so contain slowly developing as well as relatively quickly developing species. If seed production is allowed to take place in the youth of such pastures, injury of the valuable more slowly developing species may be expected.

Not usually, but occasionally, it will prove advantageous to allow worn-out pastures to run to seed in summer, provided such pastures contain satisfactory numbers of useful species which it would be worth while to increase by reseeding. If such reseeding occurs the pasture should be harrowed drastically in the autumn when the seed has ripened, and when rains sufficient to induce safe establishment of the seedlings may be expected. Under favourable circumstances such management may prove useful as a means of increasing the density of a sole of grass, especially when, for particular reasons, ploughing up of an open turf is either not desirable or not possible. However, it is well to remember that if the valuable species which it is desired to increase have fallen in numbers because of unduly low fertility, then reseeding will fail to achieve a permanent increase in their numbers unless the fertility of the area is suitably increased by top-dressing and other effective measures. Further, repairing of weakened swards by reseeding is frequently an inferior alternative to ploughing and regrassing, when these measures are practicable, as a means of obtaining improved swards.

Paramount Importance of Summer Cultivation in Crops.

Early summer brings an intensive need for much cultivation. In field work it has been demonstrated, both frequently and strikingly, that the liberal use of expensive and appropriate fertilizer and the sowing of adequate quantities of the best available seed are at most only partly effective unless linked up with adequate cultivation. Cultivation is an excellent means of minimizing much of the trouble from weeds in arable crops, but if it is viewed solely as a measure against weeds, then the amount of cultivation done is likely to be very inadequate. One of the most valuable further effects of surface cultivation in summer is the checking of the escape of moisture by evaporation from the surface of the land. This influence may be of basic importance in dry districts or dry seasons, and is normally of considerable moment in that extensive portion of New Zealand which experiences not more than 35 in. of annual rainfall.

The importance of suppression of weeds in summer, which seems at times to be underestimated, arises primarily from the ready manner in which weeds rob crops of their supplies of moisture from the soil and of direct sunlight, which are essential to growth. It is not always realized that often the greatest harm done by weeds is the cutting-off from the crops of their supplies of sunlight. Even in a soil characterized by abundant fertility, including ample moisture, crops develop very unsatisfactorily if the supply of direct light is cut off. This points to the wisdom of keeping thoroughly free from weeds those crops sown in rows wide enough apart to allow suppression of weeds to be carried out. It means that such crops as mangels, potatoes, and carrots should be " cleaning crops " in fact as well as in name.

Cultivation is the key to the growing of true cleaning crops, and too often crops which in theory are cleaning crops are raised in a way which actually fouls the land with weeds.

Apart from its beneficial influence on moisture-supply and weed-control, cultivation is of value as a means of bringing about aeration of the soil. Good aeration favours the readier utilization by the crop of the raw material for its nourishment which occurs in a soil.

For crops such as swedes, which are still to be sown, preparatory cultivation as distinct from inter-tillage will in many instances be calling for attention, and if it is considerably delayed correspondingly poor crops may be expected.

Forage-crop Considerations.

Often in early January it is useful to consider whether further strengthening of the supply of feed for winter and early spring should be arranged. For this purpose a temporary pasture, obtained by sowing 25 lb. to 35 lb. of Italian rye-grass and 4 lb. to 6 lb. of red clover an acre, may often be usefully employed. It is good practice to sow such a crop in late summer or early autumn, and it should be sown early enough to ensure a substantial supply of winter feed. It can be counted upon under normal circumstances to yield a heavy crop of hay or silage in the following season.

When the land available for summer or autumn sowing will be required again for spring sowing, then instead of temporary pasture a catch-crop of oats or black skinless barley should usually be employed. Both crops ordinarily give good results when about 2½ bushels of seed to the acre are sown. Often, and particularly in the South Island, autumn-sown temporary pastures and cereals for green feed are not sown early enough to give the best possible results. With these crops a dressing of 1 to 3 cwt. of super phosphate per acre is usually well justified. These crops, if grown after turnips which have been used at a comparatively early date or after a cereal crop, may at times be grown quite satisfactorily with a very small amount of preparatory cultivation—disking may give sufficient tilth for the seed-bed needed.

Turnip and swede sowing which remains to be done at the end of the year should be carried out at the earliest opportunity. In most localities after the middle of January it is safer to sow turnips than swedes. This is both because the turnips develop more quickly than the swedes, and because they do not suffer so severely as swedes from the ravages of insects which attack these crops in summer and autumn. The Hardy and Imperial Green Globe varieties of turnips are suitable for January sowing. Both turnips and swedes will usually respond profitably to a fertilizer dressing of 2 to 3 cwt. an acre. In such a dressing it is advisable to make superphosphate prominent, and often bonedust may be suitably included.

At this period thinning of such crops as mangols and carrots, if incomplete, should be carried on as speedily as possible, and if the seedlings are pale and seem not to be thriving sufficiently a dressing of about 1 cwt. of nitrate of soda per acre, scattered along the rows close to the plants and hoed in after thinning, may be well worth while.

General Cropping Work.

Because of the invasion of weeds lucerne sown in November or December may require mowing towards the end of January, but, unless the weeds are threatening to injure the stand, young lucerne should not be mown so early. If the young crop can be left unchecked longer this favours the development of a vigorous and extensive root-system which is likely to be of service to the crop in subsequent competition with invading plants. Although

experience justifies a preference for November or December sowing, a sowing of lucerne may be made successfully in January in many districts, if necessary.

Potatoes justify considerable attention at this season. In addition to weeding they will usually need moulding up and possibly spraying for late (or Irish) blight. Especially in districts in which the blight is likely to be severe, spraying proves more effective when utilized as a means of preventing rather than of destroying attacks of the blight. To prevent blight, spraying must be carried out in good time. As a rule better and cheaper work results from the use of sprays prepared on the farm instead of from purchased ready-made spraying materials. But spraying is likely to be futile or injurious unless the spray material is suitably prepared. Recently a modified improved method of preparing Bordeaux mixture, which is recommended for spraying potatoes for the control of blight, has been introduced by the Mycologist, Plant Research Station. A description of this method may be obtained by applying to local officers of the Fields Division.

The cutting of cereal crops at the most suitable stage of ripeness is important. Investigation has shown that it is best to cut wheat when the green colour has been replaced by yellow in the section between the top knot and the head of about 99 per cent. of the straws. At this stage all knots are still green, and while dough cannot be squeezed from the grains they are still soft enough to cut with the thumb-nail.

Generally, oats should be cut when they have a uniform yellowish appearance, but before the final touch of green has disappeared. At times oats for chaff are cut when too ripe; for chaff they can well be cut slightly earlier than the stage just described.

Frequently the use of special crops to supplement the pastures is not commenced early enough in the summer in the case of milking-stock. If, as often happens on many farms, the pastures are woody or stemmy from Christmas onwards, they no longer by themselves provide suitable feed for milking-stock. Many farmers, however, pay attention only to the ample bulk of feed available and overlook its lack of characteristics essential for fully efficient milk-production. And so they mistakenly delay starting to use suitable crops, such as early-sown, quickly-maturing soft turnips, young green lucerne, or fresh aftermath of pastures, which are available.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Thinning of Fruit.

ALTHOUGH the main thinning will have been carried out after the November drop, the grower usually finds as the season advances that the operation has not been sufficiently severe, and a second and sometimes a third operation becomes necessary. Fruits attacked by either fungi or insects may be removed with advantage at this latter stage.

The main objects of thinning may be summarized as follows: The removal of a due proportion of fruits gives to the remainder sufficient room for their full development. Having in view the vigour and crop capacity of the individual tree, the operation may be cited as one of the important factors influencing annual cropping. Production costs will be lowered through a small proportion of culls, handling will be appreciably facilitated, and the health of the tree be conserved. Broken limbs and the use of additional props are usually indicative of insufficient thinning.

Cultivation.

From mid-season onwards the fruits will be swelling rapidly, and should drought conditions be experienced light cultivation will still be necessary,

Serious damage sometimes occurs when this operation is done too deep. Interference with the small feeding rootlets at this stage is often reflected in severe droppings and loss of foliage. Orchards so situated that scouring occurs after heavy rains will require provision for an early green cover-crop.

Spraying.

In those districts where periodic rainfalls may be anticipated there should be no slackening in the summer spray programme. Provision will probably have to be made for the addition of nicotine sulphate where necessary. Black-spot affecting the foliage may be curtailed and prevented from an extension to fruits if a timely application of a fungicide is made and not more than forty-eight hours has elapsed in the interim.

Botrytis-rot injury in the calyx has been observed on several varieties for a number of years, more particularly on King David and Dougherty. Recent investigations indicate that the initial injury is due to soluble arsenic and that the rot is a secondary result. The addition of lime or sulphate of iron to the lime-sulphur and arsenical spray mixture is suggested as a partial controllant of the injury.

Harvesting.

When opportunity offers, the grading-machine should be given a general overhaul, and special care should be given to those makes having cord on the rollers. Rubber tubing of similar dimensions tacked on has been found to be an effective substitute for the cord.

Where arrangements have not already been made for the supply of all the necessities for handling the crop, such as cases, nails, wiring-machine, &c., no time should be lost in securing supplies.

Fireblight.

Uncontrolled hawthorn infection of fireblight, or neglect to remove apple and pear spurs on which blossom infection occurred, may be the cause of attack on succulent young growth through oozing. Leaf discoloration will give an early indication if this condition exists, when early cutting out and destruction are necessary. Disinfection of both the cut surface left and the tools in use is essential. The following compound is recommended as a sterilizer: Mercuric chloride, 1 gramme, hydrochloric acid, concentrated, 15 c.c., water, 1,000 c.c.

—*H. F. Frost, Orchard Instructor, Wanganui.*

Citrus Culture.

It will be necessary for some time to continue all routine work, such as spraying for the control of the various diseases, cultivation, pinching young shoots where necessary, or perhaps taking out young misplaced shoots.

At this season of the year young trees should receive particular attention, and where an excess of growth is indicated some judicious pinching or rubbing out of young shoots may be necessary. It is by small operations such as this that a good foundation can be laid that will make for future success. If the trees require a little fertilizer this should be given in the form of blood and bone, working lightly into the soil about 1 lb. per tree.

It will be noticed that often young trees only a few years from planting show an abnormally large quantity of blossoms, while the wood growth is very poor. Where this takes place it can safely be assumed that the trees have either been worked on to faulty stocks or else the soil is unsuitable for the purpose of citrus growing. If the stocks are at fault very little can be done to bring about any improvement. Moreover, where the soil is unsuitable citrus fruits will never be grown successfully. In localities where the climate and soil are both suitable, and where the necessary shelter has been provided, the young trees should come away very quickly and soon become fruit-producing.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Feeding the Layers.

FEEDING the laying birds to the best advantage at this season when they are producing their maximum egg yield is imperative if they are to prove really profitable. On the other hand, it is a mistake to provide a rich forcing diet. Nitrogenous material is essential to heavy egg-production, especially in the colder months of the year, but the supply of meat and meat substitutes, &c., requires to be controlled with considerable caution, or ovarian trouble, such as protrusion of the oviduct, will result.

In feeding fowls the special conditions must always be taken into consideration. For example, birds on free range do not require the same proportion of forcing food as birds in close confinement, and the demand for such material varies according to the birds' laying condition as well as according to their laying capacity. A case came under my notice recently where ovarian disorders were causing heavy mortality in a flock which had a good range, were given milk to drink, and had a big supply of meat-meal in the mash, while some special spice was also included in the mixture. It was easy in these circumstances to point to the cause of the trouble. In this case meat-meal was not required at all.

The weakness of an oversupply of meat food is accentuated where the supply of grain, pollard, &c., is not as liberal as it should be, the poultryman frequently reasoning that an extra supply of meat-meal will make up for the poor supply of the grain material. If meat-meal is fed in a separate receptacle and the birds are allowed to balance their own ration the risk of ovarian disorders will be greatly minimized, but where such a rich food is mixed with the mash and the same ration fed to all members of the flock, whether they be in their first, second, or third laying season, the procedure is decidedly risky.

With regard to condiments, the best argument to prove the futility of feeding these to laying birds for consistently stimulating egg-production is that the high records put up at the laying competitions are established without their aid.

The Function of Grit and Sea-shell.

The value of grit for the maintenance of fowls in a healthy thriving state can hardly be exaggerated; it should be always available to birds of all ages to pick at. Fowls have no teeth with which to masticate their food, and grit acts as a substitute, hence proper digestion cannot take place unless the gizzard contains sharp gravel-grit or similar material, and without good digestion a bird cannot maintain good health and strong bodily vigour. The lack of grit is often responsible not only for a reduced egg-yield, but is also a frequent cause of crop troubles—gizzard compaction with fibrous material, &c.—and consequent disorganization of the digestive system.

The best form of grit is small pieces of sharp gravel, stone, &c. These collect in the gizzard and thus act as teeth for the fowl. Where poultry have free range, and the ground is of a gravelly nature, the birds are afforded an opportunity of picking up all the grit they require, but on clay or sandy soil, even although they have their liberty grit should be provided, and obviously what applies in the latter case applies in greater force where the birds are confined. On the farm, where, say, one hundred fowls are kept, it is surprising how soon they will consume a dray-load of gravel, providing it is sufficiently small for the birds to swallow.

In addition to sharp stone grit, fowls should have free access to broken sea-shell or charred bones for the manufacture of egg-shells. If the annual monetary loss to the Dominion caused by the production of weak-shelled and shell-less eggs, due chiefly to birds having insufficient lime, could be

ascertained, it would be surprisingly large. Not only this, but lime is also an essential bodily requirement for birds of all ages. Growing stock will fail to make sound development and the desired size and quality of bone unless lime in some form is provided throughout all stages of development. If the value of lime to growing birds were better realized by poultry-keepers in general, the proportion of weedy, fine-boned stock now seen would be considerably reduced.

In regard to shell-less eggs, it must not be inferred that the lack of lime is always responsible for these being produced. The overfeeding of rich food, such as meat and meat-meal or condiments (which latter should never be fed to fowls), are often responsible. Where, therefore, ample sea-shell is available to fowls, and eggs with weak shells are being produced, it will be found a wise course to reduce the amount of forcing diet. This does not apply where only an odd bird in the flock may lay imperfectly shelled eggs, for even on the best managed plants, cases may occur owing to a bird being overfat, thus preventing the reproductive organs from functioning in a normal way. Such birds should be located by means of a trap-nest and eliminated from the flock.

Regarding the desirability of providing gravel-grit as well as oyster-shell, it is true that some birds do well on sea-shells alone. As a preventive, however, of liver troubles, crop and gizzard compaction, &c., sharp gravel grit is always advisable, and in the case of the heavier breeds it is essential.

Prevention of Egg-eating.

The production of weak or shell-less eggs not only means a direct loss to the poultry-keeper, but also encourages fowls to acquire the bad habit of egg-eating. Such eggs are easily broken, and once the hens have tasted the substance it will probably not be long before they learn to break the shells of the normal eggs for themselves. The habit of egg-eating is usually a difficult one to break, and preventive measures are the best means of dealing with it. To this end, as previously advised, a plentiful supply of sea-shell should always be in reach of the birds. Ample, properly arranged, and secluded nests should be provided, and care taken that the birds are not unduly forced for egg-production by means of rich stimulating food.

If fowls have acquired the habit of egg-eating a good plan is to provide sufficient dark nests, each in a deep box—say, 15 in. by 15 in.—with about 8 in. of straw chaff. The egg will then fall to the bottom and cannot be seen by the hen, which will not trouble to look for it. Another remedy that usually has the desired effect is to obtain a basket of fresh egg-shells from the baker or confectioner and throw them to the fowls whole, give them all they can eat and keep a supply before them for some days, when the sight of egg-shells will have lost its charm for them.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Use of Queen-excluders.

THE coming month should prove the advantages to be gained by the use of excluders. In the colder districts they are of inestimable value in enabling the beekeeper to finish extracting before the hot weather has altogether departed. Generally speaking, they should only be used during the main honey-flow. All sealed brood should be raised above the excluder, and the queen confined in the brood-chamber on drawn-out combs. After a few days the brood in the super should be examined in case queen-cells have been started, as it is almost impossible to find brood-combs which

do not contain a few eggs, and the bees will often raise queen-cells on brood from which the queen has been separated. The queen will continue to lay on the empty combs provided, and, as the brood in the upper story hatches, the combs will be filled with honey—a great boon to the beekeeper who does not wish to extract brood-combs. By delaying the use of excluders till the main flow has started, one of their chief disadvantages—the promotion of excessive swarming—is largely obviated, as in most localities swarming stops automatically when clover blooms freely.

Extracting Operations.

By the end of December extracting should have begun in the warmer parts of the Dominion, though farther South it may not commence till some little time later. The utensils for handling the honey should be thoroughly cleansed and scalded, and set up in the position they will occupy during the season. Everything should be tested to see that it will stand the strain of the season's work. Extracting is such high-pressure business that there is little time to stop for repairs once it commences in earnest. The uncapping-knives should be sharpened, strainers fitted with clean cheese-cloth, brakes and belts inspected, and all machinery oiled and cleaned, so that matters may run smoothly during the few weeks that the main business of the apiary is in progress.

The honey may be extracted as soon as the combs are three parts capped, and the operation repeated two or three times during the season. In fact, keeping the extractor running from the time the main flow sets in is perhaps the most satisfactory way of dealing with a honey crop, and is to be recommended where there is a possibility of thick honey being gathered. However, in clover districts, when the beekeeper possesses plenty of supers, the honey may be left in the hives till the end of the flow, and all the extracting done at one time. Although this ensures prime, well-ripened honey, it makes the handling of the crop very heavy work, and will give more trouble from robbers, which are always very much in evidence at the end of the season. In addition, in the colder districts heavily supered hives are apt to become chilled during the later part of the summer, and cold honey is much more difficult to extract than warm.

Once the honey leaves the hives it should be handled as cleanly and expeditiously as possible. Two or three zinc trays are a big help in disposing of drips, &c. One placed on the barrow which conveys the supers of combs to the honey-house, and another on the floor of the house to receive the supers prior to uncapping, will save much unpleasantness to clothes and feet. These trays should have small blocks or supports fastened in each corner to raise the supers a little, so that the drippings from burr combs, &c., may be drained away from the bottom edge of the supers. These trays are easily washed at the end of the day and drained dry ready for the next using. The extractor, uncapping-can, and honey-tank when not in use should be kept covered with clean washing covers, and care should be taken that all bees, flies, and other extraneous things are excluded from the honey. From the peculiar nature of honey-production it is impossible to clean utensils day by day as is done with most foodstuffs, and it is imperative that honey be prevented from coming into contact with dirt and foreign substances.

Provision of Supers.

On no account must the beekeeper neglect to provide his swarms with storage-room. If the weather is normal, from ten to fifteen days after a strong swarm is hived it should be provided with a super. Not only is this necessary in order to obtain a surplus, but if it is not done the newly created colony will probably swarm again. A swarm is most vigorous and will usually make more headway than an established colony, and therefore should be encouraged by the provision of ample room. Many beekeepers

deplete their honey crops considerably by failing to realize the fact that early swarms particularly will invariably yield a large surplus in a favourable season.

Ventilation of Hives.

Every care should be taken to provide the bees with plenty of ventilation during the height of the summer. All entrances should be enlarged to their utmost capacity, and where the bees show a tendency to excessive fanning or clustering out the hive should be raised from the bottom-board, and any obstruction such as weeds, grass, &c., cleared away from the entrances. Most important of all, ample room should be provided by means of supers, as the overcrowding of the hive will tend to make the bees loaf if it does not produce excessive swarming.

Foul-brood.

As soon as settled weather sets in the beekeeper should carefully examine his hives for disease, and, if necessary, treat as soon as possible, so as to give his bees a chance to gather a surplus from the main flow. On no account should the operation be delayed until the bees are bringing in large quantities of the nectar that the beekeeper requires for extracting. The "shake" or McEvoy method is the only one advocated, and the combs and frames should be treated and disposed of as soon as possible after the hives are dealt with.

Queen-raising.

The beekeeper should devote all the time he can spare to the important work of replacing old and failing queens, and if his stocks are of good quality he should endeavour to raise as many queens as possible in his own yard. Cells built under the swarming impulse are splendid for this purpose, and there are many ways of artificial queen-raising which are to be recommended. All the cells to be hatched should be given to nucleus hives to care for; queen-cells are seldom a success when introduced to full colonies. As soon as the young queens are mated and laying they should be placed in poor colonies, after killing the old queens, and their places filled by other ripe cells. —*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

THE planting of the important winter crops of savoy and red cabbage, kale and cauliflower, broccoli and Brussels sprouts, leeks and celery, should now be completed. Seasonal notes regarding these crops were printed in the November *Journal.*

Where the land is moist or the climate sufficiently humid there is considerable growth during the autumn period. Advantage of this may be taken to sow during January late crops of peas, kidney beans, silver beet, shorthorn carrots, globe beet, turnips, spinach, parsley, lettuce, and radishes, thus extending the season for these useful vegetables far beyond the period when the same crops, sown earlier, are quite exhausted. An early-maturing variety should be chosen for the pea crop, and the lettuce would generally be best sown thinly where it is to mature. Silver-beet is specially suitable for dry districts where pests make it difficult to grow good cabbage; the sowing in early autumn will provide leaves for pulling in the spring.

Runner beans should be closely picked and well supplied with water. On dry clay loams and overdrained soils a light mulch of lawn mowings

or litter will greatly assist in keeping the ground in condition. Cucumbers, marrows, and similar crops should also receive generous watering and occasional supplies of liquid manure. Cut the marrows so soon as they are of a suitable size; the flavour is then better than when they are ripe; the crop will also be greater. Thin out the growth where it is crowded and stop leader growth to induce fruiting.

Continue to spray late crops of potatoes; and where aphis is attacking carrots and crops difficult to spray effectively, dust them with soot or tobacco once a week.

Harvest shallots, garlic, and onions so soon as they mature; ripen them off well; trim them, and store in a dry, cool place.

Harvesting the Tomato Crops.

The earlier outside tomato crops will commence to ripen towards the end of January. The ripe fruit should be gathered systematically—anything overlooked will become overripe and so wasted; it also checks the development of the fruit above it on the plant. Laterals should be removed before they exceed 3 in. of growth, and the leaders should be tied to the trellis or stake as necessary.

Under glass the harvesting of the tomato crop will be at its height. All the ventilators will need to be in operation most of the time now, and even at night a good deal of top ventilation will be required. The least closeness, resulting in a humid atmosphere, will quickly induce the mould fungus disease and other troubles. Close picking and fortnightly applications of a liquid manure composed of "complete" chemical fertilizers in solution should produce a maximum crop. In the absence of a satisfactory recipe try ½ oz. each of nitrate of soda and sulphate of potash, and 1 oz. of superphosphate, to a gallon of water, applying about a quart of the solution to each plant the day after watering. If patchy ripening of the fruit takes place, an increase in the sulphate of potash ingredient should be tried. Careful attention to ventilation and watering are still of fundamental importance, as they always are with crops under glass.

Small Fruit Culture.

Land for a new planting of strawberries should be taken in hand now so soon as it is cleared. Plough or dig the ground lightly, turning in a good dressing of bonedust or other phosphate with good lasting properties, and absolutely clear it of all bad weeds—in fact, by occasional cultivation between the present and planting time, weeds and seeds of all kinds should be destroyed. If that is done, and the ground is well charged with humus, the battle for good crops is more than half won. One of the other important factors is good plants; these should now be in sight. Choose a variety that has been proved suitable to the locality. It is odd and unaccountable how varieties of plants favour certain localities and despise others, even under the most careful treatment. Avoid lavishing care, then, on ungrateful progeny that refuses to crop, by a careful choice of variety. Not only that, but, if possible, also see that the runners (as the young plants are called) are produced from parents of good constitution and performances, for plants vary widely in these respects. And to secure vigorous plants the runners to be allowed to root round the approved mother plant should be limited in number—not perhaps to four or so of the first plants on the runners, as is sometimes suggested, but to such a number that will develop into vigorous plants without manurial assistance in time for the planting season—*i.e.*, February to May. In preparation, the land should be worked with a view to gradually getting it into a condition that is fine, smooth, and firm at that period.

Some of the most popular small-fruit crops have now yielded their harvest, and the tendency is to neglect them and give attention to those

crops that are maturing. That will never do; the first thing usually required after harvesting a crop of this class is a certain amount of pruning treatment, good cleansing sprays, and a fertilizer application that will put the plants in good heart for standing the vicissitudes of winter, but without making them so soft and lush as to fall victims to low temperatures. If a crop is allowed to get into poor condition in the autumn it can be generally pulled round in the spring, but it is a very slow business. If, on the other hand, these short-lived crops have come to the end of their period of usefulness they should be pulled out or ploughed under so soon as the crop is harvested, and preparation commenced for further planting.

Plants that carry the fruit on the young one-year-old wood, as do raspberries, loganberries, and black currants, should have it completely removed immediately after fruiting; so that the new wood, which will be the fruiting wood next season, can receive more light and air to ripen it, it will be free from the contagion of what is often diseased old wood, and may be effectively sprayed to prevent the establishment of disease or to destroy any pests that may be present. A bordeaux spray of summer strength, with the addition of arsenate of lead, is generally the most important of these applications now. For manures, a few ounces of phosphates per square yard, and possibly some potash on light land or where growth is inclined to be soft; and if well-decayed farm manure for winter application is not available, a suitable green cover-crop should be sown to maintain that humus in the soil which is so necessary for making other plant-foods available and creating wholesome conditions.

The Homestead Garden.

In preparation for the planting season, which commences in May, and the strong autumn growth which commences towards the end of February, when lawns may be sown to advantage, consideration should now be given to plans for any garden alterations or new work that is to be done. So much that is pleasant, profitable, and wholesome may be obtained at a comparatively little cost in a well-planned garden in this country that the effort is well worth making. Most important is it that it should be well planned. This takes time and thought, which should now be devoted to it, seeing the near approach of those brief periods when action may be taken. Some very fine work of this kind has been accomplished here, but where efforts fall short, as they so often do, it is generally due to the fact that the plans were not fully developed or the ideas do not harmonize with the environment. As nothing in this connection is so important, it should be given the necessary time and thought to work it out and record the details by means of drawings or notes Then, when it is time to act, operations will be carried out better and quicker, because of the assurance which the plan provides.

Slight alterations often create a vast improvement. The removal of a few trees may reveal an attractive vista and give the scene depth; or where a wide panorama is unfolded from the dwelling, planting the foreground with a few strong groups of trees, shrubs, and plants improves the perspective and gives fascinating distant views a better setting. Where one is so fortunate as to have a natural garden of native bush, it too may frequently be improved, although interference is often considered as an act of vandalism. The only precaution necessary is to see that the spirit of the place is not violated, that our interference does not destroy the harmony.

Among the established trees nikau palms (*Rhopalostylis sapida*) may often be introduced with advantage where the soil is moist and deep. Or in a still more sheltered spot where the soil is always moist the large waving fronds of the tree-ferns may spread their light shade by planting a group

of mamaku (*Cyathea medullaris*) the popular black tree-fern. In a wind-swept place a group of cabbage trees (*Cordyline australis*) will thrive and form a striking note if the land is of fair quality. In a less exposed position a group of selected New Zealand flax (*Phormium tenax*), with straight blades 8 ft. or 10 ft. long and flower stalks correspondingly longer, will not fail to get their toll of appreciation.

Where the bush about the homestead may be considered to lack colour and brightness, a good sized group of kowhai (*Sophora tetraptera grandiflora*) may be planted in the richer ground to create a diversity in the spring, and on the shaded side of the group a number of plants of the Chatham Island lily (*Myosotidium nobile*) would very possibly make their home and assist the effect by spreading their broad shining leaves and bright blue flower in the vicinity of the russet and yellow of the kowhai. For summer display a bank of soil of fair quality may be planted with a generous group of kowhai—red, pink, and white (*Clianthus puniceus*); viewed from below the clusters of flowers with their great hooked keels are then shown off to great advantage. Other subjects that may be useful in adding interest, through the different seasons, to a piece of native bush that may be lacking in character are houhere (*Hoheria populnea*), the finest of the lace barks; the ratas (*Metrosideros*); clematis of sorts, especially puawananga (*C. indivisa*); the climber with scented white flowers, kaiku (*Parsonsia heterophylla*); and the native passion-vine with showy fruit, kohia (*Tetrapathaea tetrandra*).

Where undergrowth is lacking about the margin of the bush, the storms should be excluded by thick plantings on the windward side with olearias, pittosporums, coprosmas, and other shrubs that will stand the gales. To leeward of the bush the margin in nature generally spreads out in interesting groups and isolated specimens that should be imitated. Titoki (*Alectryon excelsum*), karaka (*Corynocarpus laevigata*), ngaio (*Myoporum laetum*), puriri (*Vitex lucens*), kowhai (*Sophora tetraptera*), kohekohe (*Dysoxylum spectabile*), and pohutukawa (*Metrosideros tomentosa*) are suitable for such isolation, as they have the dignity or grace which such a position demands.

Whatever additions or removals may be considered desirable, they should be noted in detail, so that the ground may be prepared and the work completed each in its due season.

—*W. C. Hyde, Horticulturist, Wellington.*

ONE OF THE SMALL-FARM PLAN COTTAGES RECENTLY ERECTED IN THE MANAWATU DISTRICT.

WEATHER RECORDS: NOVEMBER, 1932.

Dominion Meteorological Office.

THE outstanding feature of November's weather was the very low rainfall experienced in most districts. It was a typical spring month in the prevalence of north-westerly winds, gales being recorded on several occasions in the South Island and the southern half of the North. During the past few years these spring north-westers have been rather less prominent than usual, so that last month's experience was rather in the nature of a return to normal. The amount of sunshine was almost everywhere much above the average. Temperatures were rather below normal over most of the North Island and especially in Hawke's Bay, but in Wellington Province and all the South Island, except the west coast, they were above normal. The dry weather and strong winds caused the growth of pastures to be checked, but following on the October rains, feed for stock was plentiful, and in most places showers occurring at opportune times were just sufficient to maintain good conditions.

Rainfall.—The dearth of rainfall was especially marked in the North Island, most localities receiving less than half the average, while in many parts of Auckland Province, including North Auckland, the central interior, and the Gisborne districts, less than a quarter was the rule. Since most of the rain was associated with westerly depressions, the western districts from Kawhia southwards and the high levels fared rather better than the remainder of the country. In the South Island, Nelson, Marlborough, North Canterbury, and Central Otago had a very dry month. Heavy rains occurred on several occasions on the West Coast, and the deficits there were generally small and unimportant. Similar remarks apply to most of Southland and Stewart Island. In South Canterbury heavy local downpours, often accompanied by thunder, occurred on two or three occasions when a southerly change followed a warm north-wester. As a result, most of this area received more than the average fall.

Temperature.—The mean was about 1° F. below normal in Hawke's Bay and about the same amount above it in the South Taranaki Bight area. In other parts of the North Island the departures were small. In the South Island, conditions were about average on the west coast, but east of the ranges the north-westers brought high temperatures, means being 1° F. to 2° F. or even more above normal. A few frosts were recorded, but most of them light. Some damage, however, was done to tender vegetation in certain localities.

Sunshine.—Most stations recorded twenty to thirty hours more than the average sunshine. Nelson had 298·2 hours and Blenheim 287·2.

Pressure Systems.—A series of westerly depressions, six in all, crossed the Dominion during the month. The same type of weather was maintained throughout until the last two days, when disturbances in the Pacific Islands region caused a break in the succession of westerlies. Pressure remained high to the west and low to the east of New Zealand, and strong, cold, southerly winds persisted. Rains were widespread on the night of the 5th to 6th as one of these depressions passed. Many heavy falls were recorded in districts with a westerly aspect.

On the 8th, in association with a fast-moving depression, a good deal of rain was again experienced in western districts. This was one of the occasions, too, when heavy local rains occurred in Canterbury. Thunderstorms were experienced from North Otago to Wellington, and even at a few places farther north. The 26th saw another and even more violent visitation of the same nature. Thunderstorms were

particularly violent in South Canterbury. Some very severe hailstorms occurred in the same district, while violent rains were reported as far north as Kaikoura.

RAINFALL FOR NOVEMBER, 1932, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average November Rainfall.
North Island.				
	Inches.		Inches	Inches.
Kaitaia	0·38	7	0·23	2·91
Russell	0·19	4	0·10	2·38
Whangarei	0·88	8	0·39	2·90
Auckland	1·07	14	0·32	3·31
Hamilton	1·49	6	0·85	4·09
Rotorua	0·91	4	0·66	4·14
Kawhia	3·65	12	1·75	4·55
New Plymouth	1·58	11	0·49	4·82
Riversdale, Inglewood	3·94	13	0·92	9·22
Whangamomona	4·27	5	1·52	7·51
Eltham	..	..	..	4·40
Tairua	0·70	2	0·58	3·78
Tauranga	1·71	5	0·80	3·31
Maraehako Station, Opotiki	1·79	8	0·75	3·23
Gisborne	0·51	6	0·34	2·92
Taupo	1·00	6	0·52	3·51
Napier	1·08	7	0·41	2·43
Hastings	1·19	7	0·85	1·85
Taihape	2·11	12	0·79	3·52
Masterton	1·87	11	0·52	2·75
Patea	2·39	9	0·80	4·07
Wanganui	2·14	10	0·83	3·27
Foxton	1·50	8	0·48	3·28
Wellington	1·32	7	0·45	2·90
South Island.				
Westport	6·83	16	0·92	8·85
Greymouth	7·58	18	1·25	9·01
Hokitika	8·24	17	1·35	10·73
Ross	11·75	16	2·39	13·95
Arthur's Pass	15·57	14	5·10	16·14
Okuru	12·70	6	4·60	12·99
Collingwood	2·74	8	0·60	7·16
Nelson	1·18	9	0·47	2·99
Spring Creek	0·92	10	0·42	2·45
Hanmer Springs	1·05	4	0·69	3·61
Highfield, Waiau	1·25	6	0·60	2·54
Gore Bay	1·24	7	0·76	2·18
Christchurch	1·03	5	0·51	1·92
Timaru	1·65	6	0·89	1·91
Lambrook Station, Fairlie	0·52	2	0·40	1·97
Benmore Station, Clearburn	2·25	10	0·78	2·05
Oamaru	2·30	10	1·45	1·91
Queenstown	4·24	12	1·36	2·74
Clyde	0·92	7	0·41	1·35
Dunedin	1·53	17	0·35	3·25
Wendon	1·60	13	0·45	2·78
Gore	3·00	21	0·51	3·23
Invercargill	3·71	21	1·00	4·41
Puysegur Point	6·49	24	2·03	8·35
Half-moon Bay	5·87	22	0·85	5·79

Wellington, 6th December, 1932.

LIVE-STOCK IN NEW ZEALAND.

Land District.	Horses as at 31st Jan., 1932.	Dairy Cows as at 31st Jan., 1932 (in Milk and Dry).	Total Cattle as at 31st Jan., 1932 (including Figures in previous Column.)	Number of Sheep shorn, Season 1931–32.	Number of Lambs shorn, Season 1931–32.	Number of Lambs tailed, Season 1931–32.	Total Sheep (including Lambs) as at 30th April, 1932.	Pigs as at 31st Jan., 1932.
North Auckland ..	30,344	310,186	644,588	1,060,202	165,889	531,663	1,111,338	86,295
Auckland ..	43,810	516,026	982,974	1,553,935	327,751	944,456	1,506,219	169,883
Gisborne ..	16,896	50,198	369,148	2,848,632	540,359	1,259,600	2,953,817	17,946
Hawke's Bay ..	13,436	59,190	228,120	2,784,544	208,298	1,475,832	2,976,354	14,155
Taranaki ..	17,905	239,510	419,600	949,895	148,794	514,149	867,332	52,967
Wellington ..	35,952	242,036	740,518	5,377,276	1,095,246	3,088,187	5,629,455	75,511
Nelson	5,934	30,744	69,577	402,359	11,530	159,742	455,400	14,714
Marlborough ..	6,090	17,506	48,654	1,050,717	16,734	462,353	1,119,897	5,997
Westland ..	2,019	14,559	43,918	72,405	4,734	47,358	81,393	5,789
Canterbury ..	53,584	81,402	188,420	4,503,766	15,432	3,059,797	5,333,399	39,734
Otago	31,009	61,022	148,792	3,321,337	1,609	1,866,942	4,054,595	19,346
Southland ..	24,015	79,691	188,074	2,107,466	6,094	1,564,912	2,602,589	11,079
Totals, 1932 ..	280,994	1,702,070	4,072,383	26,032,534	2,542,470	14,974,991	28,691,788	513,416
Totals, 1931 ..	295,743	1,601,633	4,080,525	27,574,289	*	14,528,309	29,792,516	476,194

* Not available.

—*Census and Statistics Office.*

ESTIMATES OF THE SEASON'S LAMBING.

FOLLOWING are estimates of the current season's lambing in New Zealand computed from estimated average percentages furnished by Inspectors of Stock. Corresponding figures for the five previous years, together with the actual number of lambs tailed therein, are also given for comparison.

Year.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.	Actual Number of Lambs tailed.
		NORTH ISLAND.		
1932 ..	9,170,996	89·16	8,177,657	..
1931 ..	9,247,005	86·49	7,998,247	7,813,887
1930 ..	9,312,461	83·19	7,747,274	7,710,370
1929 ..	8,820,536	87·56	7,723,523	7,817,177
1928 ..	8,211,878	84·61	6,948,380	7,286,284
1927 ..	7,905,432	87·28	6,899,861	7,114,057
		SOUTH ISLAND.		
1932 ..	7,892,064	88·42	6,978,494	..
1931 ..	8,361,724	87·13	7,285,914	7,161,104
1930 ..	8,251,714	84·43	6,967,041	6,817,939
1929 ..	7,787,619	89·87	6,998,691	7,070,422
1928 ..	7,322,173	87·74	6,424,887	6,569,674
1927 ..	6,926,298	86·17	5,968,979	6,064,915
		DOMINION.		
1932 ..	17,063,060	88·82	15,156,151	..
1931 ..	17,608,729	86·79	15,284,161	14,974,991
1930 ..	17,564,175	83·77	14,714,315	14,528,309
1929 ..	16,608,155	88·65	14,722,214	14,887,599
1928 ..	15,534,051	86·09	13,373,267	13,855,958
1927 ..	14,831,730	86·76	12,868,840	13,178,972

District Estimates.

The following table gives estimates of the current (1932) season's lambing for the several sheep districts :—

Sheep District.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.
Auckland..	1,807,831	86·77	1,568,709
Napier-Gisborne	3,835,873	89·31	3,426,156
Wellington - West Coast ..	3,527,292	90·23	3,182,792
Marlborough-Nelson-Westland	778,036	77·40	602,256
Canterbury-Kaikoura ..	3,396,623	92·75	3,150,632
Otago (including Southland)	3,717,405	86·77	3,225,606
Dominion	17,063,060	88·82	15,156,151

—*Live-stock Division.*

Ragwort Control with Sodium Chlorate.—A Pohangina farmer reports that 1 cwt. of sodium chlorate was more than sufficient this year to deal with an area of ragwort which last year required more than half a ton, and he is extremely pleased with the results generally.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith Letters should be addressed to the Editor.

LIME FOR DRINKING-TROUGHS.

W. J. BURTON, Kerepeehi :—

Would you kindly advise me regarding the kind of lime suitable to put in the drinking-troughs for stock, that would kill any parasites which might be in the water and also be beneficial to the health of stock—the quantity per 100 gallons, and how often ?

The Live-stock Division :—

The form in which the lime should be used is burned lime that has been slaked. When lime is put in the drinking-troughs it is not possible for the animals to take in a stated quantity daily. This, however, is not of any great importance. The usual way of giving the lime is to put a shovelful in each trough every few weeks, but before each renewal the trough should be thoroughly cleaned out. The application of lime to the water-troughs will not kill parasites by itself, but when the trough is well cleaned out at every fresh application they are prevented from breeding and infestation is kept down.

DIMENSIONS FOR TOBACCO-CURING SHED.

"FARMER," Wakefield :—

Can you please tell me the dimensions of a 2-acre tobacco-shed with a gable roof ? I want especially to know the height of the shed.

The Horticulture Division :—

The dimensions of a shed for air-curing a 2-acre tobacco crop are as follows: 32 ft. long, 16 ft. wide, and 16 ft. to the eaves. This allows for eight bays of 4 ft. wide, and four tiers of hanging poles. For kiln-curing, the area of 2 acres is too small to fill a standard kiln with ripe leaves, and the time spent on curing leaf in an undersized kiln would be too costly.

FEEDING MIXED MILK TO YOUNG CALVES.

"SUBSCRIBER," Tokomaru :—

Can you tell me whether it is harmful to give mixed milk—*i.e.*, dipped out of vat—to young calves ? I recently lost two calves which, when opened, were found to contain thick hard milk. The milk had been warmed.

The Live-stock Division :—

The system of feeding mixed milk to young calves is not a good one. It is liable to cause digestive troubles, of which you report some evidence. It is more desirable to feed young calves their milk ration either as fresh milk or as sour milk. The holding-vat requires to be cleaned out at regular intervals. It is also advisable to scald the vat from time to time. Attention to these matters and to the cleanliness of other feeding-utensils being used will assist in the reduction of losses. Another common cause of digestive trouble among young calves is the use of too large quantities of milk at this season of the year.

Lime and Superphosphate Mixture.—Throughout the West Coast district of the South Island last year outstanding results were obtained from a mixture of lime and super for manurial purposes, as compared with super alone.

PRICE-LIST OF WINES

made at

TE KAUWHATA HORTICULTURAL STATION.

WINE IN CASE.

(A case contains 12 reputed quarts—2 gallons.)

Delivery ex Departmental Store, Auckland, Wellington, Christchurch, and Dunedin.

FRONTIGNAC (sweet red)	30s. per case.
MADEIRA (sweet white)	30s. per case.
ASSORTED CASES OF THE ABOVE	30s. per case.

Delivery f.o.r. Te Kauwhata.

FRONTIGNAC (sweet red)	30s. per case.
MADEIRA (sweet white)	30s. per case.
CLARET (dry red)	25s. per case.

(Any assortment of the above can be packed to a case if required.)

WINE IN BULK.

(From Te Kauwhata only.)

FRONTIGNAC and MADEIRA can be supplied in bulk if required, provided suitable containers are supplied by the purchasers, but not otherwise. (Bottles not accepted; kegs or jars only.) Freight on containers forwarded for filling must be prepaid. Bulk rates are as follows:—

2 gallons	10s. per gallon (£1).
5 gallons	9s. 6d. per gallon (£2 7s. 6d.).

(Rates for larger quantities supplied on application.)

PLACING OF ORDERS, AND CONDITIONS OF SALE.

Orders should be forwarded to any one of the following: Manager, Horticultural Station, Te Kauwhata; Director, Horticulture Division, Department of Agriculture, Wellington; District Chief Clerk, Department of Agriculture, Auckland; District Clerk and Accountant, Department of Agriculture, Christchurch and/or Dunedin.

Minimum quantity sold, 2 gallons. Cheques payable to "Department of Agriculture," and crossed "Public Account." Orders cannot be accepted unless accompanied by a remittance covering the price of the wine, and the exchange when drawn on banks outside Auckland, Wellington, Christchurch, and Dunedin. All freight to flag stations and ports beyond the railway must be prepaid. Under the Licensing Amendment Act, 1914, wine cannot be sent into a no-license area excepting on an "order signed by and stating the address and occupation of the purchaser thereof."